PB 189 194

AIR QUALITY DISPLAY MODEL

TRW Systems Group
Washington, D. C.

November 1969

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH SERVICE

NATIONAL AIR
POLLUTION CONTROL
ADMINISTRATION

AIR QUALITY DISPLAY MODEL

FOREWARD

The Air Quality Display Model was developed within NAPCA for the computation of seasonal and annual concentration estimates. It is to be considered as a provisional dispersion model for estimating air quality until continuing research indicates an improved model is available. This manual for using the computer program of the model was prepared under contract.

The reader should pay particular attention to the limitations imposed by simplifying assumptions in the dispersion model stated on pages 2-6 and 2-7 and the note about large single sources as it affects the statistical model on page 2-8.

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Bureau of Criteria & Standards

January 29, 1970

AIR QUALITY
DISPLAY MODEL

November 1969

Prepared for

Department of Health, Education and Welfare
Public Health Service
Consumer Protection and Environmental Health Service
National Air Pollution Control Administration
Washington, D.C.

TRW
SYSTEMS GROUP

The work upon which this publication is based was performed pursuant to Contract No. PH-22-68-60 with the U. S. Public Health Service, Department of Health, Education and Welfare.

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1.0 INTRODUCTION

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1.0 INTRODUCTION

This manual describes the use of the Air Quality Display Model, a computer program designed to estimate the spatial distribution of sulfur dioxide and particulate concentrations. Application of the AQDM to analysis of a specific region will require a general purpose computer, certain input data, the instructions contained in this manual, and the program itself (in the form of a deck of cards or a magnetic tape).

The AQDM program is written in FORTRAN IV (level G) and is designed for installation on an IBM 360/40 (or equivalent) computer. The program and this manual are available from the National Air Pollution Control Administration; the user supplies the computer, installs the program, and prepares the input data according to the procedures described in this manual. He then runs the program and interprets the printed output. A brief outline of the structure and usage of the AQDM is given in the following paragraphs.

Through a mathematical simulation of the atmospheric diffusion process [Martin and Tikvart, 1968], the program determines the estimated arithmetic average pollutant concentrations at ground level over an annual period. The resulting spatial distribution of average concentration values is obtained in both tabular and punched-card form. The punched-card output is designed to be used either with a program for the x-y plotter [CALCOMP, 1968], which produces contour-line maps (isopleths) of the various concentration levels in the region, or with the SYMAP [1968] program, which produces the same isopleths but in the form of shaded-area diagrams. These isopleth maps give a complete regional picture of air quality which could be used for submission of levels of air quality along with air quality standards [Guidelines, 1969, Sec. 2.22, page 19].

To provide a direct comparison with air quality criteria, AQDM includes a statistical model [Larsen, 1969] which is used to transform average concentration data from a limited number of receptor points into expected geometric-mean and maximum-concentration values for several different averaging times.

For each pollutant, the user may select a basic set of up to 237 receptor locations within the region for which estimated average concentration values are to be computed. From this basic set, 12 locations may be selected to provide additional output consisting of (1) expected geometric mean and (2) expected maximum concentrations for up to three different averaging times.

For each pollutant type, the AQDM also provides a table which gives the average concentration contribution from each source to any five receptors selected from the basic set of 237. The contribution is indicated both as an average concentration and as a percentage of the total average concentration at the specified receptor. If no selection is made by the user, data for the five receptors reporting the highest total average concentrations will automatically be entered.

The program can also be used in an analysis of control-device effectiveness. By scaling down the emission rates in the emission inventory in accordance with the efficiency of applicable devices, the impact of controls on air quality may be estimated. However, a more efficient and less costly means of calculating the effects of a control strategy will be forthcoming in the Implementation Planning Model to be reported to NAPCA in March 1970.

Chapter 2 of this manual describes the functions of the atmospheric diffusion and statistical models and, in a general sense, their input data requirements. A description of the options available for correlating the diffusion model with observed pollutant concentration data is also included. A detailed mathematical description of both models is given in Appendix A.

Chapter 3 describes the preparation of input data, including details on data formats, types, accuracies, and units. Upon completion of the steps described in Chapter 3, data necessary to run the AQDM will have been assembled in a convenient form. A sample case ("Test City") is introduced in Chapter 3 and is used throughout the remainder of the manual to provide examples of proper procedures and formats (i.e., sample data sheets for Test City are included in Chapter 3, sample loadsheets in Chapter 4, and sample output in Appendix C).

Chapter 4 provides instructions on procedures for transcribing the data collected in Chapter 3 onto computer loadsheets. The input card deck is keypunched from these loadsheets and fed directly into the computer.

Although the AQDM is relatively simple to use, the accuracy of its results is strictly dependent upon the degree to which the input data-AQDM combination represents the physical situation within the region of interest. Since each region will have certain unique requirements, the user may need to consult the nearest NAPCA Regional Office (Appendix B) before, and possibly during, the application of the AQDM.

2.0 PROGRAM DESCRIPTION

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The pollutant concentration output from the AQDM is derived from (1) an atmospheric diffusion model, which transforms regional source emission and meteorological data for a given annual period into estimated arithmetic average pollutant concentration values, and (2) a statistical model, which determines the geometric mean and expected maximum concentration values. Calculation of these parameters by the latter model is based on (a) arithmetic concentration values from the diffusion model, (b) input values of the standard geometric deviation* of the pollutant concentration, and (c) selected averaging times. The basic input data required by these models is discussed in the following sections. A detailed description of the structure of the models is given in Appendix A.

Before using the AQDM to estimate regional air quality, the atmospheric diffusion model should be calibrated with existing air quality data (various calibration options are provided in the AQDM). In addition to the source emission and meteorological data, the following information is required for calibration:

(a) Existing Air Quality Data. For each pollutant, from 3 to 100 values of observed average concentrations may be specified, together with the respective receptor locations. The data must cover the same annual period represented by the emission inventory and meteorological data.

(b) Background Concentration. Average background concentration values for each pollutant type may be specified. These values represent that part of the regional pollutant concentration not attributable to the sources within the region. Background concentration data may be omitted if accurate values are not available, since a correlation option (detailed below) is provided which will automatically account for the background levels.

The calibration procedure (repeated for each pollutant) begins with the use of the diffusion model to calculate concentration values at each of the measuring sites. The calculated values at these points will include any input background values. Note that no receptor locations need be specified, since the program will automatically use the input measuring stations as receptor points. A least-square regression line of observed (i.e., measured) concentration values on the calculated values is then obtained. This procedure is used to determine the straight line which best fits the plot of calculated vs observed concentrations. The scatter diagram below illustrates the procedure. Each point plotted represents both the calculated and observed concentration values at a given receptor. For each pollutant, then, there is a regression line:

---

*Sometimes referred to as the geometric standard deviation.

$$\hat{\chi}_p = A_p + B_p \chi_p$$

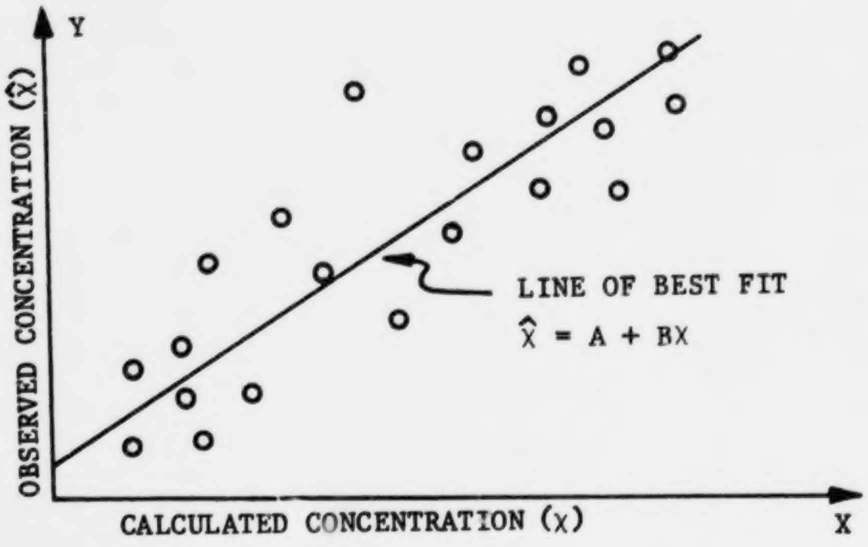
where

$\hat{\chi}_p$ = observed concentration of pollutant p,

χ_p = calculated concentration of pollutant p,

A_p = y-axis (observed concentration) intercept of best-fit line,

B_p = slope of best-fit line.



Since the observed concentration values include the background concentration, the line of best fit will have the same slope, B_p, whether or not background values are input. Inclusion of background values (which are added to the calculated values) simply shifts the line of best fit to the right. Thus the y-axis intercept, A_p, will automatically account for missing input background concentration values.

If the regression line adequately describes the relationship between the observed and calculated concentration values, it may then be applied to the region in general (within the range of calculated values used to determine the regression line). The model output would thus be adjusted at each receptor point according to the regression line equation.

To determine if the regression lines are adequate, the coefficient of correlation, a measure of data-scatter about the regression line, is calculated and compared with the maximum theoretical value that could arise due to chance.* The maximum theoretical value is determined for a 5% confidence level (that is, there are fewer than 5 chances in 100 that a coefficient of correlation as high as this value would arise due to random sampling variation). If the coefficient of correlation is greater than the theoretical value, the regression line is used to adjust the calculated values. If, on the other hand, the coefficient of correlation is less than the theoretical value, the regression line will not be used. A poor correlation warns the user that the input data (e.g., emission inventory, meteorological data, and observed concentration data) should be revised and, if an improved correlation does not result, the model assumptions should be reviewed by a meteorologist familiar with such modeling techniques.

If only a limited number of observed concentration values are available (fewer than 20 for most regions), or if their locations cover only a small portion of the region, calibration of the model may not be meaningful. However, it would still be of interest to check the model output against the known data points. In this way at least a partial check of the model's adequacy can be made. So that such checks may be performed and the regression results analyzed prior to region-wide application, the program has the following options:

OPTION	PROGRAM DESCRIPTION
0	The user must input the regression constants A_p and B_p. The program will apply the resulting regression line equations to the calculated concentration values prior to output.

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*For a general discussion of these concepts, see Fisher [1954].

OPTION	PROGRAM DESCRIPTION
1	The program will determine the regression lines and, if correlation is good, will adjust calculated concentration values accordingly. If the correlation is poor, the calculated concentrations will be output without adjustment and a message printed to indicate that poor correlation was obtained. In either case, the regression constants and correlation coefficients are output.
2	The program will determine the regression lines and correlation coefficients and stop.

Since model correlation is usually a trial-and-error process involving refinement of the input data, Option 2 is most economical. If accurate background levels are known, they should be used; otherwise, it is best to let the correlation procedure account for background values. Once good correlation has been achieved, Option 0 can be used. (Note, however, that if input background values are used in determining the coefficients A_p and B_p in Option 2, then the same background input values must be used in Option 0.)

2.1 ATMOSPHERIC DIFFUSION MODEL

The Martin-Tikvart [1968] diffusion model is based on the Gaussian-diffusion equation which describes the spreading, or diffusing, of a plume as it is transported downwind from an elevated, continuously emitting point source. The model is utilized here to compute annual arithmetic average ground-level pollutant concentrations resulting from specified point and area sources. The model calculates the effects of each source on each receptor for the observed combinations of wind direction, wind speed, and stability class. The relative frequency of occurrence for each combination is then included as a factor, and the resulting data are summed for each receptor over all combinations and all sources. The plume is assumed to be normally distributed about its center line (i.e., a Gaussian distribution) in the vertical direction and distributed as a linear function of crosswind distance in the crosswind direction. The pollutant distribution in the vertical direction is controlled by the magnitude of the vertical standard deviation of pollutant concentration. The program uses the vertical standard deviation values given by Pasquill [1961] and Gifford [1961]. These values are functions of the source-receptor downwind distance and atmospheric stability category. The stability categories (1 through 5, in order of increasing stability) are defined on the basis of the objective criteria specified by Turner [1964]. These categories are used to define both the standard deviation of the plume concentration distribution and the mixing depth of the atmosphere.

Input data to the diffusion model includes the following:

(a) Receptor Data. Up to 225 receptor locations corresponding to the intersections in a grid pattern having equidistant vertical and horizontal spacing may be specified, together with a maximum of 12 individually located receptors. The grid pattern is defined by the location of its lower left-hand corner, the number of rows and columns of receptors, and the distance between adjacent rows and columns. A convenient system with which to specify the receptor locations is the Universal Transverse Mercator system described in Section 3.0.

(b) Correlation Data. Depending on the correlation option (as discussed in the introduction to this section), the correlation coefficients and/or pollutant background levels may be input for one or both pollutant types.

(c) Source Data. Both area and point sources may be specified. For each point source the location, average annual emission rate (tons/day), and exhaust stack parameters must be specified. The stack parameters (physical stack height, stack exit diameter, effluent exit velocity, and effluent temperature) are used to obtain the effective height of release (i.e., the height at which the plume becomes horizontal) for use in the diffusion calculations. If the stack parameters are not known, an effective stack height value may be input. For each area source (assumed square in shape) the area, centroid location, average annual emission rate, and effective height of release must be input.

(d) Stability Wind Rose Data. This data gives the relative frequency of occurrence for each wind direction, wind speed class, and stability category combination* as observed for the region and time period of interest. Although the wind direction is a continuous variable, for purposes of computation it is specified in sectors corresponding to 16-point compass headings, with sectors 1 through 16 corresponding to winds blowing from the directions N, NNE,

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*These terms are defined in Appendix A.

NE,....., NW, and NNW, respectively. Since there are 5 stability classes, 16 wind directions, and 6 wind speed classes, the complete set of stability wind rose data consists of 480 frequency values. When summed over all categories, the relative frequency is 1.0. The diffusion model utilizes a single set of stability wind rose data for the entire region. For some regions this data may already be available in the required format. To check on data availability and/or for assistance in processing local meteorological data, consult the nearest NAPCA Regional Office (Appendix B).

(e) Mixing Depth. The mixing depth is defined as the depth above the surface through which the pollutants are mixed. Since this depth varies greatly from season to season, day to day, and diurnally, it is practical to account for only major changes. The program uses a single input value--the annual average afternoon mixing depth--and modifies it according to the stability class. If the mixing-depth value is not available, it may be estimated from Holzworth's [1964] estimates of the monthly mean afternoon mixing depths in the contiguous United States.

The diffusion model described above should only be applied when competent meteorological advice is available to interpret the limitations in the model. Important cautionary notes include:

(a) The basis of the model calculations, the point source diffusion formula, was developed to represent the behavior of plumes from actual point sources. The field data available for confirmation of the plume behavior were obtained from open, flat terrain and for travel distances of no more than a few kilometers in most cases. Thus, the use of the point-source model for urban scale projections has three specific weaknesses: (1) area sources are only imperfectly modeled by "effective point sources"; (2) plume behavior during horizontal transport of more than a few miles is not well known; and (3) plume behavior in regions of varying thermal and surface-roughness characteristics has not been systematically observed.

(b) The climatological data used in the model calculations is obtained from airport weather observing stations in nearly all cases. Frequently, the character of the lower atmosphere varies significantly between an out-of-town observing site and the urban central region.

(c) The use of surface meteorological data only in the estimation of mixing-layer depths has not been very successful. Better modeling should result when climatological data based upon vertical wind and temperature soundings is used.

(d) The emission inventories presently available for use in the model calculations are subject to error, and they cannot fully describe the variability within the urban region.

(e) The present model uses annual average emission inventory data. However, significant diurnal and seasonal variabilities in emission rates normally occur. Such variabilities are often (partially) correlated with the stability wind rose data. A future version of the model should include co-variable meteorological and emissions data in the development of annual average concentration estimates.

The listing of limitations cited here is not intended to imply that the present model be kept from use. On the contrary, improved models can only be developed when significant experience with the present formulation has been achieved.

2.2 STATISTICAL MODEL

The statistical model [Larsen, 1969] is used to define the distribution of pollutant concentrations at each selected receptor as a function of averaging time, arithmetic average concentration, and standard geometric deviation at the given receptor. This statistical output includes such concentration distribution characteristics as the geometric mean concentration, expected maximum concentration, and standard geometric deviation (all of which are output for each of the specified averaging times).

The model is constructed on the basis of the following empirical characteristics of pollutant concentration distributions:

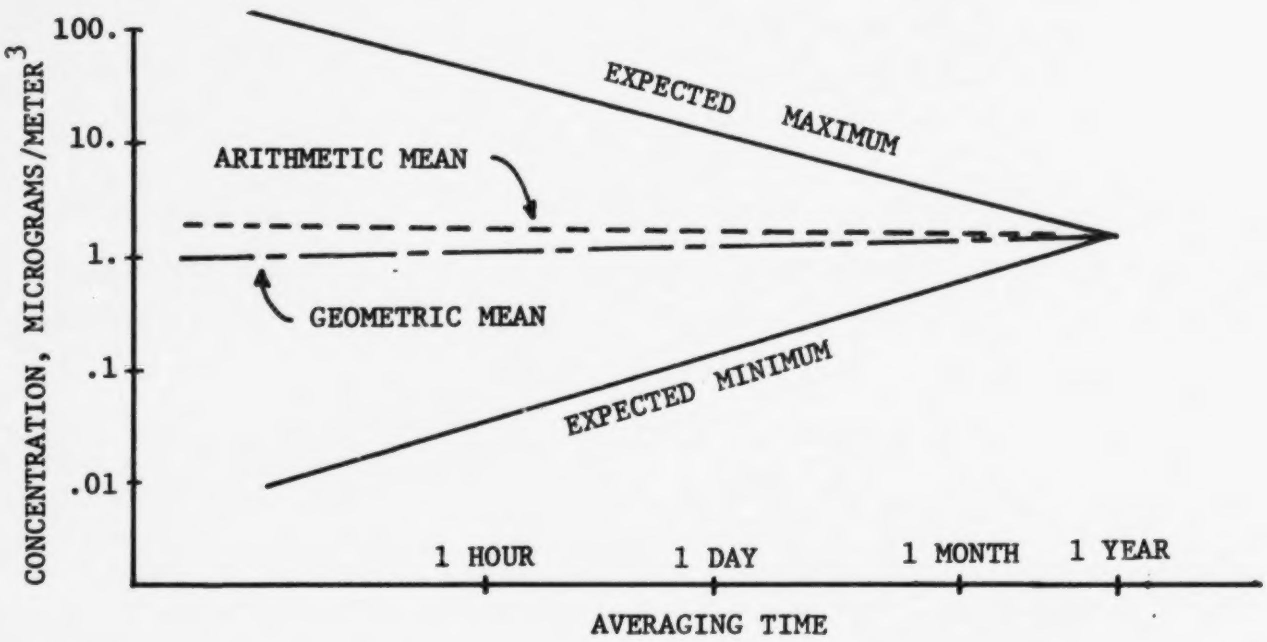
(a) Concentrations are lognormally distributed for all pollutants in all cities for all averaging times.

(b) The median (geometric mean) concentration is proportional to averaging time raised to an exponent.

From these characteristics, relationships between the arithmetic-mean, geometric-mean, and expected maximum concentrations are obtained. These relationships are illustrated in the sketch on the following page. A key result of the model is that the arithmetic mean is not a function of averaging time, and the arithmetic mean line in the figure is thus horizontal.

The standard geometric deviation, which describes the slope of the concentration-vs-frequency line for a fixed averaging time, does not appear here but is required in order to relate the arithmetic mean to the geometric mean and expected maximum concentration.

It should be noted that concentrations due to large single sources are not usually distributed lognormally. Thus, the model projections must be viewed conservatively in localities where a few single sources account for the major fraction of the observed concentrations. In particular, the frequency of occurrence of high concentrations may be underestimated by the model when a large single source exists in the neighborhood of a receptor location.



In addition to the arithmetic average concentration value at each receptor selected for output, the following input data to the statistical model is required:

(a) Output Receptor Selection. For each pollutant, a maximum of 12 output receptor locations may be selected from the basic set (for which arithmetic average concentrations have been computed).

(b) Standard Geometric Deviation. For each of the selected output receptors, a standard geometric deviation value for a 24-hour averaging time must be input for each pollutant (the program automatically converts this value to the desired averaging time). For output receptors located at measuring sites, the standard geometric deviation values will be obtained from the measuring station data. For output receptors not located at measuring sites, the standard geometric deviations must be interpolated from nearby measuring station values.

(c) Averaging Time. Three different averaging times for each pollutant type may be specified. A set of data will be output for each averaging time selected. These averaging times may be any desired values, but are most effectively determined after a study of the air quality statements in the Criteria Documents [1969].

3.0 PREPARATION OF INPUT DATA

3.0 PREPARATION OF INPUT DATA

To permit optimum utilization of a computer-based mathematical model such as the AQDM, input data must be completely and accurately prepared. Field data must be collected, the region must be studied to determine which program operating modes to use, and decisions must be made concerning output format.

In this manual, the preparation of the input data has been separated from the transcription of that data into a format acceptable to the computer (i.e., filling out loadsheets to provide instructions for keypunching). Once the steps described below for preparing input data have been completed, filling out the loadsheets becomes a routine task.

The nine steps for input data preparation fall into two basic groups: (1) field data collection (Steps A,B,C and D) and (2) program operating and output format selection (Steps E,F,G,H and I). The field data collection steps are essentially independent of each other and may be performed simultaneously. All data collection must be completed before the program mode selection steps are begun. The mode selection steps must be completed serially, since each step is dependent upon completion of the prior step. A field-data-collection or mode-selection step is complete when the field data collection form associated with that step has been filled out (with the exception of Step A, which is complete when a satisfactory map has been obtained and a coordinate system selected). All of the data entered on the collection forms will be input to the computer, in various forms.

A sample procedure, based on the hypothetical "Test City", is presented in this and the following section. This sample case is used both as a means of illustrating each of the steps described below and, through the completed forms showing data for the test case (Figures 3-B through 3-I), as a way of indicating the level of accuracy required for each data type. The characteristics of Test City (number of sources, number of measuring stations, etc.,) have been scaled down to make the presentation more compact. The results of the AQDM run for Test City should therefore not be regarded as meaningful for any particular region.

STEP A. SURVEY THE REGION

Before beginning the actual preparation of input data, it is important to obtain an overall picture of the region under study, to select a coordinate system, and to survey the available data. Completion of the items below will give the user this regional picture.

(1) Obtain a map of the region and the surrounding area. The U.S. Geological Survey (USGS) metropolitan area topographical maps are suggested for this purpose. Indexes to topographical maps published for each state showing the area included in each metropolitan area map and the date of survey may be obtained from the U.S. Geological Survey, Washington, D. C. 20242.

(2) Locate approximately the major sources in the region, as well as any commercial and residential areas which are likely to be significant area sources. Names and locations of point sources may be obtained from the Director of Manufacturers of the local Chamber of Commerce. Land-use and population density maps (available from metropolitan or city planning commissions) also provide a good index of the areal distribution of pollutant emissions. This information is obtained at an early stage in the input data preparation process to provide a guide in determining the portion of the region where air quality estimates from the AQDM program are needed.

(3) Locate approximately the sampling stations in the region.

(4) Outline the approximate area where air quality estimates, in the form of isopleths of concentrations at ground level, are desired.

(5) On the basis of the locations plotted in items (2), (3) and (4), select a coordinate system which will assure positive coordinates for all sources, receptors, and sampling stations. The origin of the coordinate system, if it appears on the map at all, will be in the southwest portion with coordinate values increasing toward the east and north. The Universal Transverse Mercator (UTM) system [Department of the Army, 1958 through 1967] is a convenient choice, since almost all USGS maps include horizontal and vertical UTM tick marks in the margin and there is a growing body of emission inventory, meteorological and air quality data in this system. The X and Y axes of this metric coordinate system are oriented in the east and north directions, respectively. Because of the way in which the UTM system divides the globe into zones, care must be taken when the region of interest involves more than one zone (not a common occurrence, since the entire continental United States is covered by only 10 zones).

The Army Map Service (AMS) has developed tables (TM 5-241-2, Zone-to-Zone Transformation) to be used for conversion from one UTM zone to another. Assistance in using the UTM system may be obtained from the nearest NAPCA Regional Office (Appendix B). A local coordinate system may be used if desired, but the origin must be far enough to the southwest that all coordinates are positive. Regardless of which coordinate system is selected, all emission inventory, receptor, and sampling station coordinates for a region must be expressed in the same system.

(6) Survey the available emission-inventory, meteorological, and sampling data, and select the most recent 12-month period for which all three data types are available. The aim is to make the data current, compatible (all three types for the same time period and in the same coordinate system), and complete (as described below in Steps B, C, and D). The nearest NAPCA Regional Office (Appendix B) should be contacted at an early date to determine how much of this data they can provide.

Step A for the Sample Case

Test City was postulated to be in a single UTM zone, with horizontal and vertical tick marks as shown in Figure 3-A. The origin of this particular zone was well off the map to the southwest. The approximate coordinates of the central business district, determined on the basis of the horizontal and vertical UTM tick marks, are X = 575 kilometers, Y = 4395 kilometers. Thus, none of the location coordinates for sources, receptors, or sampling stations will be negative.

STEP B. COLLECT EMISSION DATA

(1) Obtain the emission inventory for the selected 12-month period. A description of the emission inventory data desired for use in modeling is given in Appendix C of the Guidelines [1969].

(2) If emission data is not available or is outdated, conduct an emission inventory to gather such data. The Rapid Survey Technique [Ozolins and Smith, 1966] can be used to perform an inventory or update existing data, but a more complete inventory should be conducted if possible.

(3) Record the data in the emission inventory as shown in Figure 3-B. Data for columns (1) through (5) can be collected using the Rapid Survey Technique. Column (1) contains the source numbers, with point sources listed first; the numbers run consecutively from 1 to the total

number of sources in the region (no more than 1000 sources can be input). The source name, column (2), is listed only for the convenience of the program user; these names are not used by the program itself. The X,Y coordinates listed in column (3) are measured in kilometers from the origin selected in Step A. For area sources, the coordinates are measured to the center of the (assumed) square area. The source area, entered in column (4), is in square kilometers. The emission rates in column (5) are in tons/day, averaged over the year. Generally, the area sources are in the form of geographic zones which produce a contiguous set of area-source squares covering the region. The size of each area source should be selected on the basis of such common characteristisc as fuel and land-use patterns and population density.

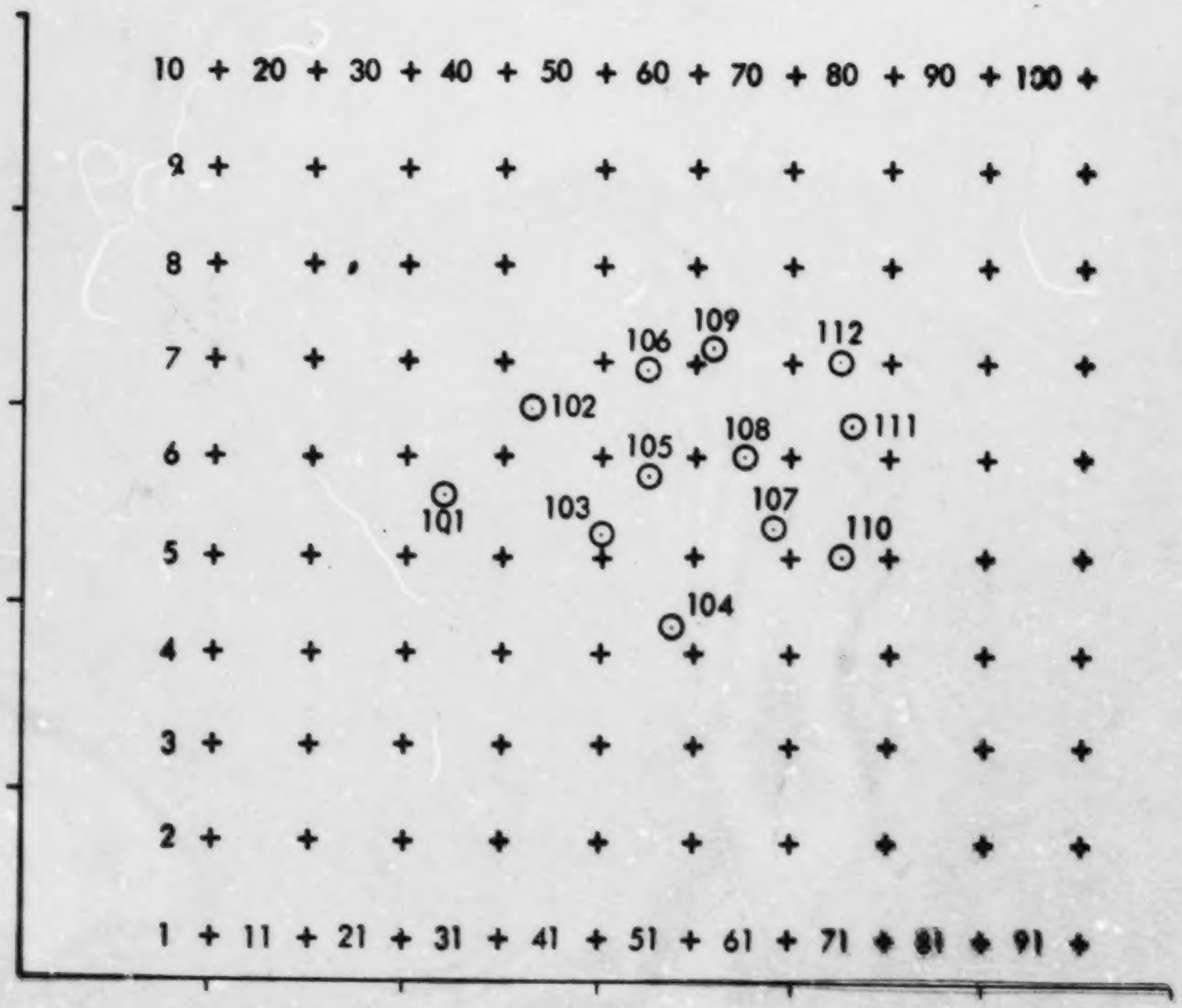
The items in columns (6) through (9) are not a part of the Rapid Survey Technique and must be obtained from each individual point source. The physical stack height is entered in column (6). The data in columns (7) through (9) are used to calculate the increment to the physical stack height due to plume rise. If these data are not available, an estimated plume-rise increment may be added to the physical stack height and the sum entered in column (6), or the physical stack height only may be used. In any case, if there are no values in columns (7), (8), and (9), the program will assume that the effective height of pollutant release is the value entered in column (6).

For area sources, the average height of effective pollutant release should be entered in column (6); columns (7), (8) and (9) have no meaning for area sources. Before proceeding to the next step, verify that the emission inventory data used is for the selected year and that columns (1) through (6) have been completed for all sources.

(4) Mark on the map the location of the major sources. These points will serve as an aid in selecting receptor locations. Among the point sources there will usually be several that have much larger emission rates than any of the other sources. Large power plants and steel mills are frequently in this category. At least these largest sources should be located on the map.

Step B for the Sample Case

A total of 21 sources were used in the sample case, four of which were point sources. For source (1), it was considered that stack exit conditions were not available and, therefore, an estimate of the effective stack height was used. The point sources in the region are indicated by the triangles along the river (See Figure 3-A). Note also that a single,



TEST CITY RECEPTOR LOCATIONS

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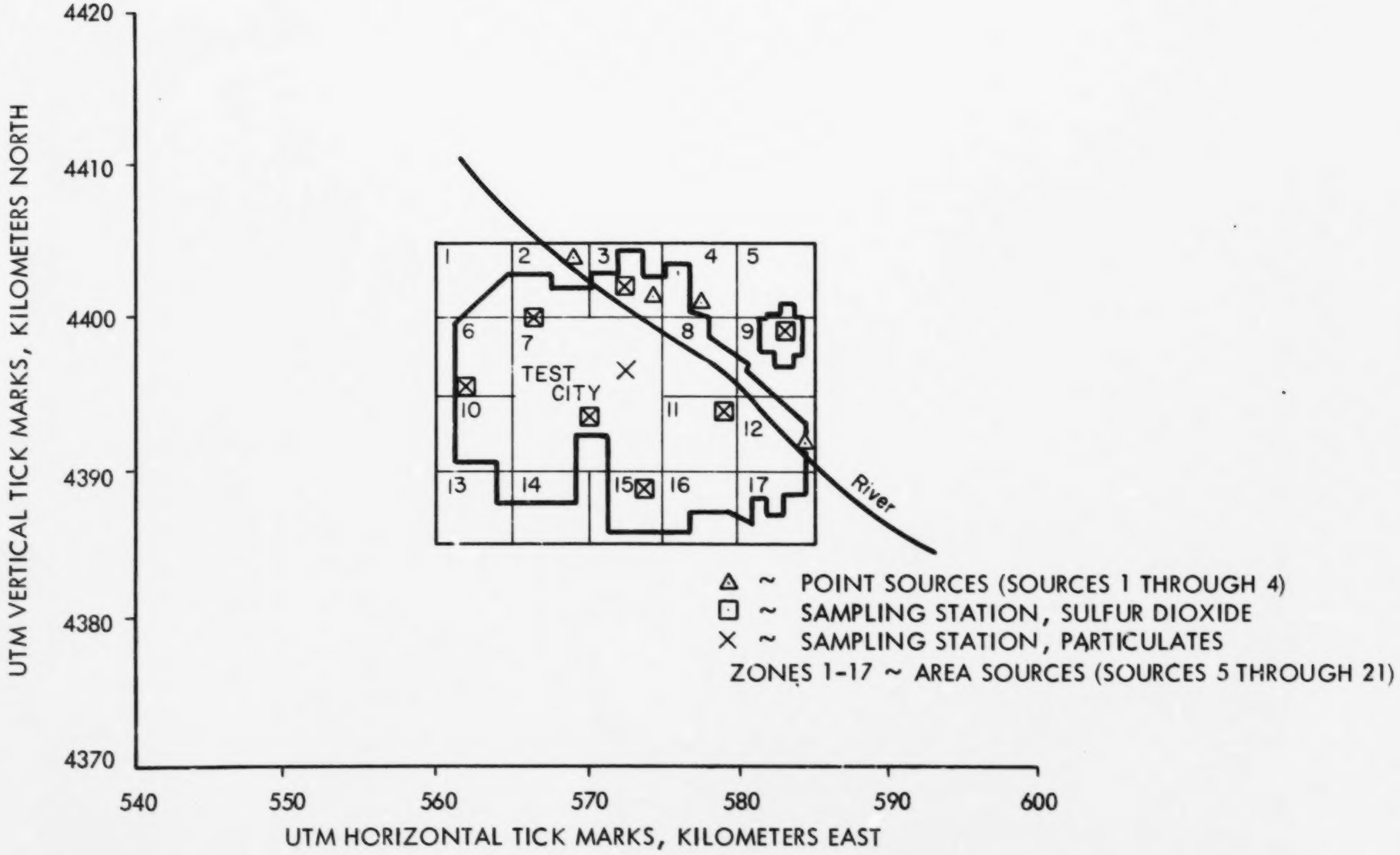

UTM VERTICAL TICK MARKS, KILOMETERS NORTH
4420
4410
4400
4390
4380
4370
540
550
560
570
580
590
600
UTM HORIZONTAL TICK MARKS, KILOMETERS EAST
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
TEST CITY
River
△ ~ POINT SOURCES (SOURCES 1 THROUGH 4)
□ ~ SAMPLING STATION, SULFUR DIOXIDE
× ~ SAMPLING STATION, PARTICULATES
ZONES 1-17 ~ AREA SOURCES (SOURCES 5 THROUGH 21)

TEST CITY BASE MAP

Figure 3-A. Test City Base Map

large area source is used to represent the downtown area emissions. In general, city-center emission patterns may require a series of relatively small area sources.

STEP C. COLLECT METEOROLOGICAL DATA

The stability wind rose table in the upper portion of Figure 3-C describes the annual relative frequency of occurrence for each combination of 5 stability classes, 16 wind directions, and 6 wind speed classes (these terms are defined in Appendix A). When summed over all combinations, the relative frequency equals 1.0. This data can be obtained by processing local meteorological data or from Weather Bureau type 1 data cards; for some regions, it may already be available in the required format. The average annual ambient temperature and pressure may be obtained from the local Weather Bureau station. The average afternoon mixing depth values, if not available, may be determined from data tabulated by Holzworth [1964]. The Guidelines [1969] indicates that, if not available locally, appropriate meteorological data for use in diffusion models may be obtained from the National Weather Records Center of the Environmental Science Services Administration, Asheville, North Carolina. The following procedure is to be followed:

(1) List the stability wind rose data according to the format shown in Figure 3-C.

(2) Record the values for average afternoon mixing depth, ambient temperature, and ambient pressure that are assumed to apply throughout the region, as illustrated in the lower table in Figure 3-C.

Step C for the Sample Case

The meteorological data selected for use in Test City is shown in part in Figure 3-C; a complete listing of the stability wind rose data (which has been abbreviated in this figure) is included in the Test City output (Appendix C, pages C-3 to C-7).

STEP D. COLLECT SAMPLING STATION DATA

(1) Survey the sampling station data to find out what is available. In order to use the AQDM calibration option, values of the annual arithmetic mean from at least three stations are required per pollutant, measured in micrograms/meter^3. However, values from a somewhat larger number of stations are required for a reliable calibration (See Chapter 2).

(2) Record the background concentration (that occurring naturally or from sources outside the region) for each pollutant. The background concentration is assumed to be constant throughout the region.

(3) For those stations providing calibration values, transform the station locations to the coordinate system selected in Step A and record the locations and measured values as shown in Figure 3-D. One form is used for each pollutant; there may be up to 100 stations per pollutant. The station name is for the user's benefit only and is not used by the program.

(4) Record the standard geometric deviation (24-hour averaging time), if available, as shown in the last column of Figure 3-D. This data is not used in calibration, but including it here provides a convenient record for developing data needed later for statistical output computations.

(5) Locate on the map the calibration sampling stations recorded on the form as shown in Figure 3-D.

Step D for the Sample Case

Acceptable data from seven SO_2 sampling stations and eight particulate stations was considered to be available and, therefore, model calibration was possible. One of the stations is a Continuous Air Monitoring Program (CAMP) station, while the others are local stations run by the city. The locations are noted on the Test City map (Figure 3-A), with a square indicating an SO_2 station and an X representing a particulate station.

STEP E. SELECT PROGRAM OPTIONS

(1) At this point, three questions should be answered regarding the mode of program operation:

(a) Are pollution concentration isopleths to be plotted (either SYMAP or CALCOMP)?

(b) How is calibration to be handled?

(c) What pollutants are to be considered?

The possible answers to these questions are listed in Figure 3-E and discussed below.

Examples of the concentration isopleths that can be plotted using the AQDM punched card output are shown in Appendix C, pages C-25 through C-28. Punched-card output must be requested if either the CALCOMP or SYMAP program is to be used to produce these plots.

The calibration options range from "compute concentrations only" (i.e., no calibration) to "determine regression constants only" (i.e., no concentration output). The first two choices (of the four listed in Figure 3-E, opposite "AQDM Operating Mode") can be selected only when sufficient sampling station data is available. If the data is available for only one pollutant, the model can be calibrated for that pollutant only.

The third choice may be selected only if regression constants from a previous run are available; for this option sampling station data is not needed.

Where data for two pollutants are input but the single pollutant option is selected, the program option will override all other input. For example, if SO_2 only is selected, regardless of what particulate sampling station data may be input or what particulate output receptors may be called for, only SO_2 calibration and printed and punched output will take place.

(2) After these questions have been considered, record the options selected, as illustrated in Figure 3-E.

Step E for the Sample Case

Options selected for the Test City case are indicated in Figure 3-E. They include consideration of both pollutants, calibration of the model, computation of the concentrations, and the punching of cards for plotting concentration isopleths.

STEP F. STRUCTURE RECEPTOR GRID

(1) Review the rectangular grid receptor area determined in Step A, verifying that grid receptors correspond to the desired points in the area to be covered. The grid receptor area should be at least large enough to enclose the sources plotted in Step B.

(2) Read the X, Y coordinates of the southwest corner of the rectangular grid receptor area and record them as shown in Figure 3-F; this is the grid origin. In the overlay to Figure 3-A, receptor number 1 is located at the grid origin.

(3) Select the spacing between rows and columns of grid receptors (same spacing is used for both), based on the size and source density of the region. Some experimentation may be necessary here, but in general the spacing

should fall somewhere between 1 and 10 kilometers. Using this spacing and the dimensions of the rectangular grid area, compute the number of rows and columns of grid receptors required. Record the number of rows, the number of columns, and the spacing in Figure 3-F.

(4) Compute the total number of grid receptors by multiplying the number of rows by the number of columns, and record the product in Figure 3-F. A maximum of 225 grid receptors may be entered. If this number is exceeded, a respacing of rows and columns is necessary.

(5) Number and locate on the map those grid receptors which lie on the rectangular boundary of the grid receptor area. Numbers should run consecutively, increasing from bottom to top within each column and, by column, from left to right. Thus, the first grid receptor (number 1) will be located in the southwest corner, and the last receptor (number equal to the total number of grid receptors), in the northeast corner. An example of the receptor grid numbering system is shown in the overlay to Figure 3-A.

Step F for the Sample Case

A receptor grid with 10 rows and 10 columns and spacing of 5.0 kilometers was selected for Test City (overlay to Figure 3-A). Using the horizontal and vertical UTM tick marks on Figure 3-A, the X and Y coordinates of the grid origin (receptor number 1 on the overlay) were determined to be 550 km and 4372.5 km, respectively.

STEP G. AUGMENT RECEPTOR GRID

The arithmetic mean, statistical, and source contribution output are provided only for numbered receptor points selected by the user from the basic set comprising the grid receptors (set up in Step A) and the non-grid receptors (selected here). This step allows the user to designate locations in the region, other than those defined by the grid receptors, where he may want any or all of these output types. If any of these types of output is desired at, e.g., a sampling station, the coordinates of the station must be input as a non-grid receptor (unless the station location happens to coincide with a grid receptor). Sampling stations selected for calibration are used only for that purpose; none of the output data is provided for these locations unless the user designates a numbered receptor at that point. Thus, the calibration and output selection activities are completely separate.

The following actions are to be taken:

(1) Study the map of the region, noting where the sources and sampling stations are located and the coverage of these locations provided by the grid receptors.

(2) Place non-grid receptors (up to 12) at points where a greater definition of pollutant concentrations than that provided by the grid receptors is desired (e.g., central business district, a high source-density area, etc.) or where potential or existing sampling stations are located. Establishing non-grid receptors at the sampling station sites allows subsequent selection (Steps H and I) of statistical and source contribution output for these stations, information which is of great value in interpreting air quality measurements.

(3) After all non-grid receptors have been selected, number them, continuing from the last grid receptor number, and record the numbers and associated locations as shown in Figure 3-G. The receptor descriptions called for in this format are for user convenience only; they are not used by the program.

Step G for the Sample Case

Since 100 grid receptors were selected for Test City, the non-grid receptors are numbered 101 through 112. Non-grid receptors 101-107 and 111 were established at sampling station locations to provide a basis for statistical and source contribution output. Non-grid receptors numbered 108, 109, 110 and 112 were added for better definition of pollutant arithmetic mean concentrations in an area of anticipated critical pollution.

STEP H. SELECT RECEPTORS FOR STATISTICAL OUTPUT

These receptors could be measuring stations, residential areas, or any other areas for which estimates of the maximum and geometric mean concentrations are desired for various averaging times. An example of the output of this information for a one-hour averaging time is shown on page C-15 of Appendix C.

(1) From among the set of grid and non-grid receptors already established and numbered in Steps F and G, select up to 12 for each pollutant for statistical output. Also select the averaging times (up to three) desired for each pollutant. Record the numbers of the receptors selected and the desired averaging times for each pollutant, as shown in Figure 3-H.

(2) The standard geometric deviation (based on a 24-hour averaging time) for each receptor and each pollutant is required before the statistical output can be computed. These quantities can be reliably obtained only from measured data, and will apply only to the location at which the measurements were made. For those receptors selected for statistical output which are located at sampling station sites, the standard geometric deviations, generally available as part of the (processed) data records, can be used. For the other receptors, it will be necessary to estimate the standard geometric deviations by interpolation from adjacent stations, and the resulting statistical computations will be less reliable. After the standard geometric deviations have been estimated or determined from sampling station data records, record them in the format shown in Figure 3-H. The source column is suggested as a convenience to the user for noting whether or not the standard geometric deviation was estimated or derived from measured data; this information is not used by the program.

Step H for the Sample Case

The sites of all of the sampling stations for each of the pollutants were selected as receptor locations for calculated statistical output. In addition, five SO_2 and four particulate receptors were selected to give statistical output for other locations in the region. Standard geometric deviations derived from measured data have been entered using two decimal places; those which were estimated were entered using only one decimal place.

STEP I. SELECT RECEPTORS FOR SOURCE CONTRIBUTION OUTPUT

For some receptors, especially those with high concentrations, it is of interest to know how much each source contributes to the total ground-level concentration at that receptor, on both an absolute (micrograms/meter^3) and a percentage basis. An example of the output that provides this information is shown on page C-21 of Appendix C. The user may select five receptors by receptor number from the set of grid and non-grid receptors established in Steps F and G. If the user makes no designation, the program calculates the source contributions to each of the five receptors with the largest total concentrations at ground level for each pollutant.

If the five receptors are to be selected, record the receptor numbers as illustrated in Figure 3-I. The receptor descriptions are for the user's convenience; they are not used by the program.

Step I for the Sample Case

For SO_2, source contribution output was selected for two central city receptors (numbers 46 and 55), an industrial park receptor (number 109), a receptor on the river adjacent to the largest source in the region (number 110), and a northeast suburban location receptor (also the site of City Station #7). Three of the selected particulate receptors are the same as the SO_2 receptors (numbers 109, 110, and 111). In addition, a downtown receptor (number 105) and a suburban growth area (number 112) were selected.

(1)	(2)	(3)		(4)	(5)		(6)	(7)	(8)	(9)
SOURCE NUMBER	SOURCE NAME*	SOURCE LOCATION		SOURCE AREA (KILOMETER^2)	ANNUAL AVERAGE EMISSION RATE (TONS/DAY)		PHYSICAL STACK HEIGHT (METERS)	STACK EXIT VELOCITY (METERS/SEC)	STACK DIAMETER (METERS)	STACK EXHAUST TEMPERATURE (DEG, KELVIN)
		X (KILOMETERS)	Y (KILOMETERS)		SO_2	PARTICULATES				
1	Power Plant	568.5	4403.4	0.	130.000	50.250	150.0	0.0	0.0	0.
2	Power Plant	584.2	4391.6	0.	150.510	75.200	90.0	15.2	8.7	422.
3	Industry	577.0	4401.1	0.	21.120	3.250	30.0	17.8	.7	788.
4	Industry	574.1	4401.5	0.	10.500	5.150	23.0	15.2	1.4	533.
5	AS1	562.5	4402.5	25.	.130	.160	0.0			
6	AS2	567.5	4402.5	25.	.120	.170	0.0			
7	AS3~Lt. Indust.	572.5	4402.5	25.	.500	.380	10.0			
8	AS4~Open Burn.	577.5	4402.5	25.	.140	1.250	0.0			
9	AS5	582.5	4402.5	25.	.110	.150	0.0			
10	AS6	562.5	4397.5	25.	.250	.140	10.0			
11	AS7~Commercial	570.0	4395.0	100.	3.110	2.010	15.0			
12	AS8~Lt. Residen.	577.5	4397.5	25.	.520	.380	10.0			
13	AS9~Residential	582.5	4397.5	25.	.630	.550	10.0			
14	AS10	562.5	4392.5	25.	.250	.110	10.0			
15	AS11~Downtown	577.5	4392.5	25.	.750	.490	20.0			
16	AS12~Lt. Indust.	582.5	4392.5	25.	.500	.350	10.0			
17	AS13	562.5	4387.5	25.	.260	.130	0.0			
18	AS14	567.5	4387.5	25.	.230	.180	10.0			
19	AS15	572.5	4387.5	25.	.510	.390	10.0			
20	AS16	577.5	4387.5	25.	.530	.370	10.0			
21	AS17~Lt. Indust.	582.5	4387.5	25.	.270	.140	10.0			

*AS = AREA SOURCE; NOTE THAT POINT SOURCES ARE LISTED FIRST

Figure 3-B. Emission Inventory

STABILITY WIND ROSE DATA

STABILITY CLASS	WIND DIRECTION	FREQUENCY					
		SPEED CLASS					
		1	2	3	4	5	6
1	1	.0000	.0000	.0000	.0000	.0000	.0000
	2	.0000	.0000	.0000	.0000	.0000	.0000
	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	16	.0000	.0000	.0000	.0000	.0000	.0000
2	1	.0005	.0005	.0000	.0000	.0000	.0000
	2	.0000	.0000	.0000	.0000	.0000	.0000
	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	16	.0000	.0000	.0000	.000		
5	1	.0051	.0124	.0212	.0000	.0000	.0000
	2	.0005	.0028	.0046	.0000	.0000	.0000
	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	16	.0032	.0115	.0069	.0000	.0000	.0000

METEOROLOGICAL CONSTANTS

MIXING DEPTH (METERS)	1000.
AMBIENT TEMPERATURE (DEGREES KELVIN)	288.
AMBIENT PRESSURE (MILLIBARS)	1000.

Figure 3-C. Meteorological Data

POLLUTANT SO_2

BACKGROUND CONCENTRATION (MICROGRAMS/METER^3) 1.0

STATION NAME	STATION LOCATION (KILOMETERS)		MEASURED VALUE OF ANNUAL ARITHMETIC MEAN CONCENTRATION (MICROGRAMS/METER^3)	STANDARD GEOMETRIC DEVIATION (24 HR AVERAGING TIME)
	X	Y		
City Station #1	562.0	4395.7	10.	1.81
" " #2	566.1	4400.0	18.	1.79
" " #3	570.0	4393.2	12.	1.83
" " #4	573.9	4388.9	14.	1.77
" " #6	572.4	4402.2	50.	2.35
CAMP Station	579.0	4394.0	20.	2.96
City Station #7	583.0	4399.2	16.	1.92

Figure 3-D. Sampling Station Data

POLLUTANT PARTICULATES

BACKGROUND CONCENTRATION (MICROGRAMS/METER^3) 1.0

STATION NAME	STATION LOCATION (KILOMETERS)		MEASURED VALUE OF ANNUAL ARITHMETIC MEAN CONCENTRATION (MICROGRAMS/METER^3)	STANDARD GEOMETRIC DEVIATION (24 HR AVERAGING TIME)
	X	Y		
City Station #1	562.0	4395.7	6.	1.70
" " #2	566.1	4400.0	10.	1.67
" " #3	570.0	4393.2	8.	1.72
" " #4	573.9	4388.9	11.	1.65
" " #5	572.5	4396.7	9.	1.72
" " #6	572.4	4402.2	26.	2.01
CAMP Station	579.0	4394.0	8.	1.82
City Station #7	583.0	4399.2	7.	1.80

Figure 3-D (Continued). Sampling Station Data

PUNCHED DECK OUTPUT FOR PLOTTING ISOPLETHS		DO NOT PUNCH DECK
	✓	PUNCH DECK FOR PLOTTING MAPS
AQDM OPERATING MODE	✓	CALIBRATE AND COMPUTE, i.e., DETERMINE REGRESSION CONSTANTS AND USE TO COMPUTE ADJUSTED CONCENTRATIONS
		CALIBRATE ONLY, i.e., DETERMINE REGRESSION CONSTANTS ONLY
		COMPUTE CONCENTRATIONS AND ADJUST USING INPUT REGRESSION CONSTANTS
		COMPUTE CONCENTRATIONS ONLY; REGRESSION CONSTANTS ARE NOT INPUT
POLLUTANTS TO BE CONSIDERED		SO_2 ONLY
		PARTICULATES ONLY
	✓	SO_2 AND PARTICULATES

Figure 3-E. Program Options

PARAMETER	VALUE
GRID ORIGIN: X, Y (KILOMETERS)	550.0, 4372.5
NUMBER OF ROWS OF RECEPTORS	10
NUMBER OF COLUMNS OF RECEPTORS	10
SPACING BETWEEN ROWS AND BETWEEN COLUMNS (KILOMETERS)	5.0
TOTAL NUMBER OF GRID RECEPTORS (NUMBER OF ROWS TIMES THE NUMBER OF COLUMNS)	100

Figure 3-F. Grid Receptor Parameters

RECEPTOR NUMBER	RECEPTOR DESCRIPTION	LOCATION (KILOMETERS)	
		X	Y
101	City Station # 1	562.0	4395.7
102	" " #2	566.1	4400.0
103	" " #3	570.0	4393.2
104	" " #4	573.9	4388.9
105	" " #5	572.5	4396.7
106	" " #6	572.4	4402.2
107	CAMP Station	579.0	4392.0
108	River~ Central	577.5	4397.5
109	Industrial Park	576.0	4403.0
110	River~ South	582.5	4392.5
111	NE Suburb (City Station #7)	583.0	4399.2
112	NE Expansion Area	582.5	4402.5

NOTE: NON-GRID RECEPTORS ARE NUMBERED FOR OUTPUT PURPOSES BEGINNING WHERE THE GRID RECEPTOR NUMBERS END

Figure 3-G. Non-Grid Receptor Locations

POLLUTANT SO_2

DESIRED AVERAGING TIMES (HOURS) 1.0 , 8.0 , 24.0

RECEPTOR NUMBER	STANDARD GEOMETRIC DEVIATION	
	VALUE	SOURCE
34	1.8	Estimated
55	1.9	"
64	1.8	"
101	1.81	City Station #1
102	1.79	" " #2
103	1.83	" " #3
104	1.77	" " #4
106	2.35	" " #6
107	1.96	CAMP Staton
109	2.3	Estimated
111	1.92	City Station #7
112	1.9	Estimated

POLLUTANT PARTICULATES

DESIRED AVERAGING TIMES (HOURS) 4.0 , 8.0 , 24.0

RECEPTOR NUMBER	STANDARD GEOMETRIC DEVIATION	
	VALUE	SOURCE
55	1.7	Estimated
64	1.7	"
101	1.70	City Station #1
102	1.67	" " #2
103	1.72	" " #3
104	1.65	" " #4
105	1.72	" " #5
106	2.01	" " #6
107	1.82	CAMP Station
109	2.0	Estimated
111	1.80	City Station #7
112	1.8	Estimated

Figure 3-H. Receptors Selected for Statistical Output

POLLUTANT SO_2

RECEPTOR NUMBER	DESCRIPTION
46	North Central Business District
55	Downtown
109	Industrial Park
110	River - South
111	NE Suburb (City Station # 7)

POLLUTANT PARTICULATES

RECEPTOR NUMBER	DESCRIPTION
105	Downtown (City Station # 5)
109	Industrial Park
110	River~ South
111	NE Suburb (City Station #7)
112	Suburban Expansion Area

Figure 3-I. Receptors Selected for Source Contribution Output

4.0 OPERATING INSTRUCTIONS

4.0 OPERATING INSTRUCTIONS

Once all of the data sheets in Chapter 3 have been completed, the next step is to transcribe the data onto loadsheets, which are used as key-punch instructions in producing the input card deck. The present chapter describes the procedures for performing this transcription.

The figures in Chapters 3 and 4 are arranged so that figures with the same letter contain identical data but in a different arrangement. For example, Figure 3-B and Figure 4-B contain identical emission data but in a different format. In Chapter 3 the data is arranged as it might be collected in the field. The unshaded portion of the even-numbered page of the correspondingly lettered figure in Chapter 4 presents the same data re-arranged on a loadsheet format that can be key-punched directly onto computer cards. The facing (odd-numbered) page contains instructions for transcribing the initially collected data and information onto the load-sheet in the required format. The transcribed material on the loadsheet is then key-punched on cards, with care being taken to maintain the precise order of the loadsheet. The sequential arrangement of the data groups as they must appear on key-punched cards is shown in Figure 4-1. This figure also shows the page reference to the figure which describes the corresponding loadsheet and card instruction format for each data group (Figures 4-A through 4-I).

Note that a standard 80-column loadsheet is used. Such loadsheets can be obtained from any computer service center. A horizontal line on the loadsheet corresponds to a single punched card. The following rules apply to each of the lines on the loadsheet:

- Every horizontal line on the loadsheet is divided into eight 10-column fields, lettered (a) through (h).
- The data is placed in these fields, one data value per field.
- The data type is identified by the name of the variable, which is always written in field (a) starting in column (2). The code name of each variable must be used in the exact form shown in the glossary of AQDM input variables (pages 4-32 and 4-33).

- Whenever an entry is made in a data value field [fields (b) through (h)], a comma must be placed in the last column of that field. Thus, commas will always appear in columns whose numbers are multiples of 10. The first comma on any horizontal line will appear in column (20), since no comma is used after the variable name.

- If none of the data value fields are used, the entire card is omitted.

- When a data value with a decimal point is used, it may be placed anywhere in the field, and zeros are not required after the decimal points. However, for ease in checking the completed loadsheets, decimal points should be placed in the same column when there are several values for the same data type, as in the second field in Figure 4-2.

- When an integer value is used without a decimal point (e.g., a receptor number), it must be placed to the far right in the field with no blank columns between it and the comma (i.e., it must be right-justified).

To begin preparation of a complete set of loadsheets, prepare the input data control identification cards described in Figure 4-A. Then transcribe the data from the first data sheet described in Chapter 3 (Figure 3-B) onto the loadsheet as specified in Figure 4-B. Generally, the data on the data sheet will be in the order of entry on the loadsheet, and the column headings on the data sheets will correspond to the loadsheet field descriptions. Proceed through the remaining lettered data groups in this same manner.

After all of the lettered data groups have been entered on loadsheets, the following checks should be made to avoid errors in the input card deck:

- Column (1) should be blank on all cards.

- Names of variables only (no data values) should appear in field (a).

- Names of variables should all end with an equal sign (this does not include &INDATA and &END, which are not names of variables), and there should be no gaps (blank columns) between the first letter of the variable name and the equal sign.

- There should be as many commas as there are data values on each horizontal line.

- Commas should not appear in any columns other than those which are multiples of 10, starting with column (20).
- There should be no cards which contain only the name of a variable (i.e., with no data values).
- The first card should be &INDATA and the last card should be &END.

When the loadsheets are submitted for keypunching of data onto cards, it will be necessary to specify that the cards be punched, verified, and sequence-numbered. Sequence-numbering is of great benefit in maintaining the deck of cards in its mandatory order.

A complete set of loadsheets for the sample case is shown in Figure 4-2. The input card deck punched from these loadsheets produces the output data shown in Appendix C. As a familiarization exercise, it is suggested that the user:

(1) Transcribe the information from the sample data sheets (Chapter 3) onto loadsheets following the instructions given in Chapter 4. The loadsheets thus prepared may then be compared to those shown in Figure 4-2. (It should be noted that, since meteorological data is not presented in detail in Chapter 3, it will be necessary to consult Appendix C, pages C-3 through C-7, for this input.)

(2) Have an input deck prepared for the sample case from the loadsheets completed in step (1) and use it to run an AQDM analysis of Test City.

(3) Verify that the output is the same as that presented in Appendix C.

After completing this exercise, the user should be in a position to prepare and run the AQDM program with his own data.

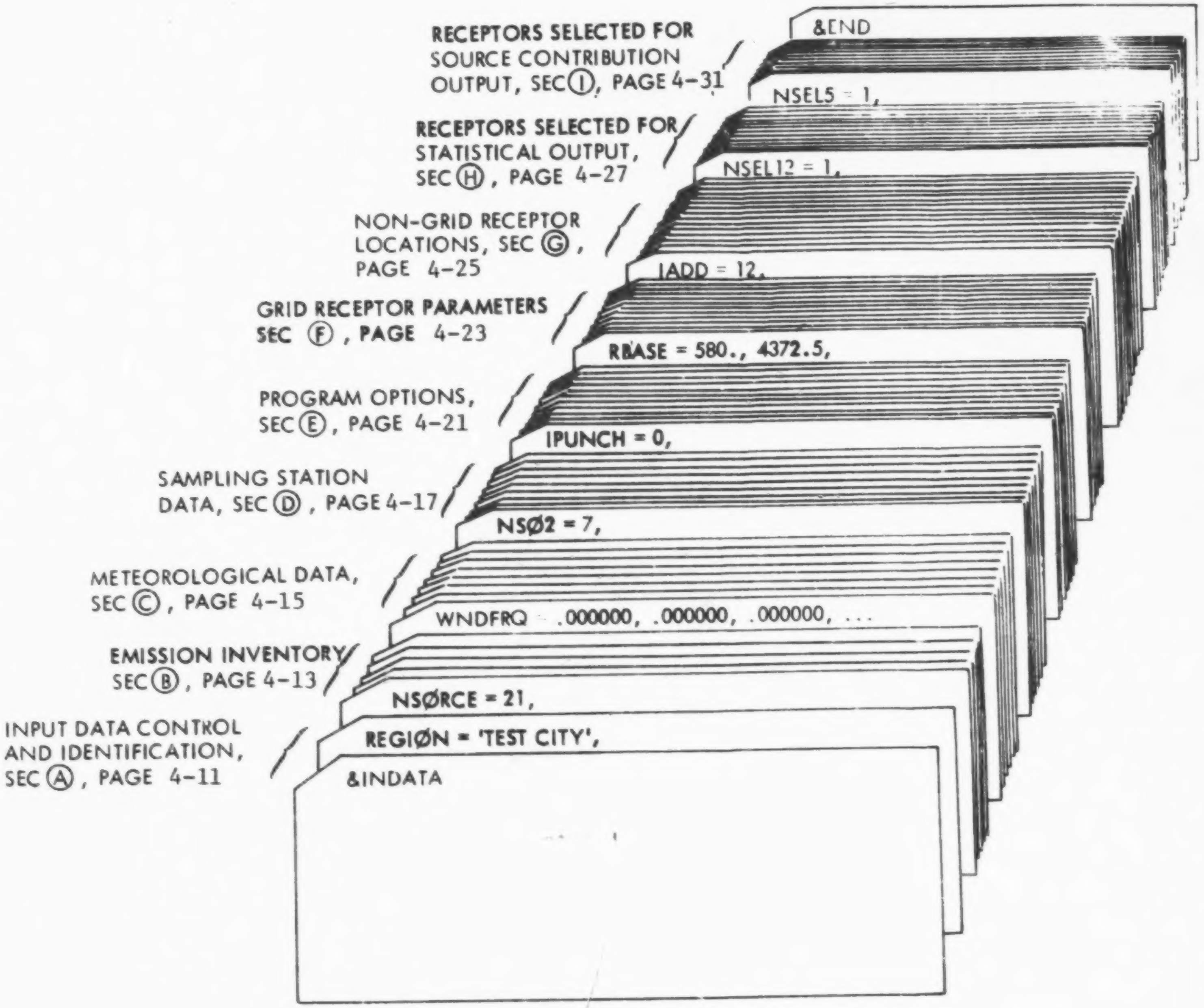
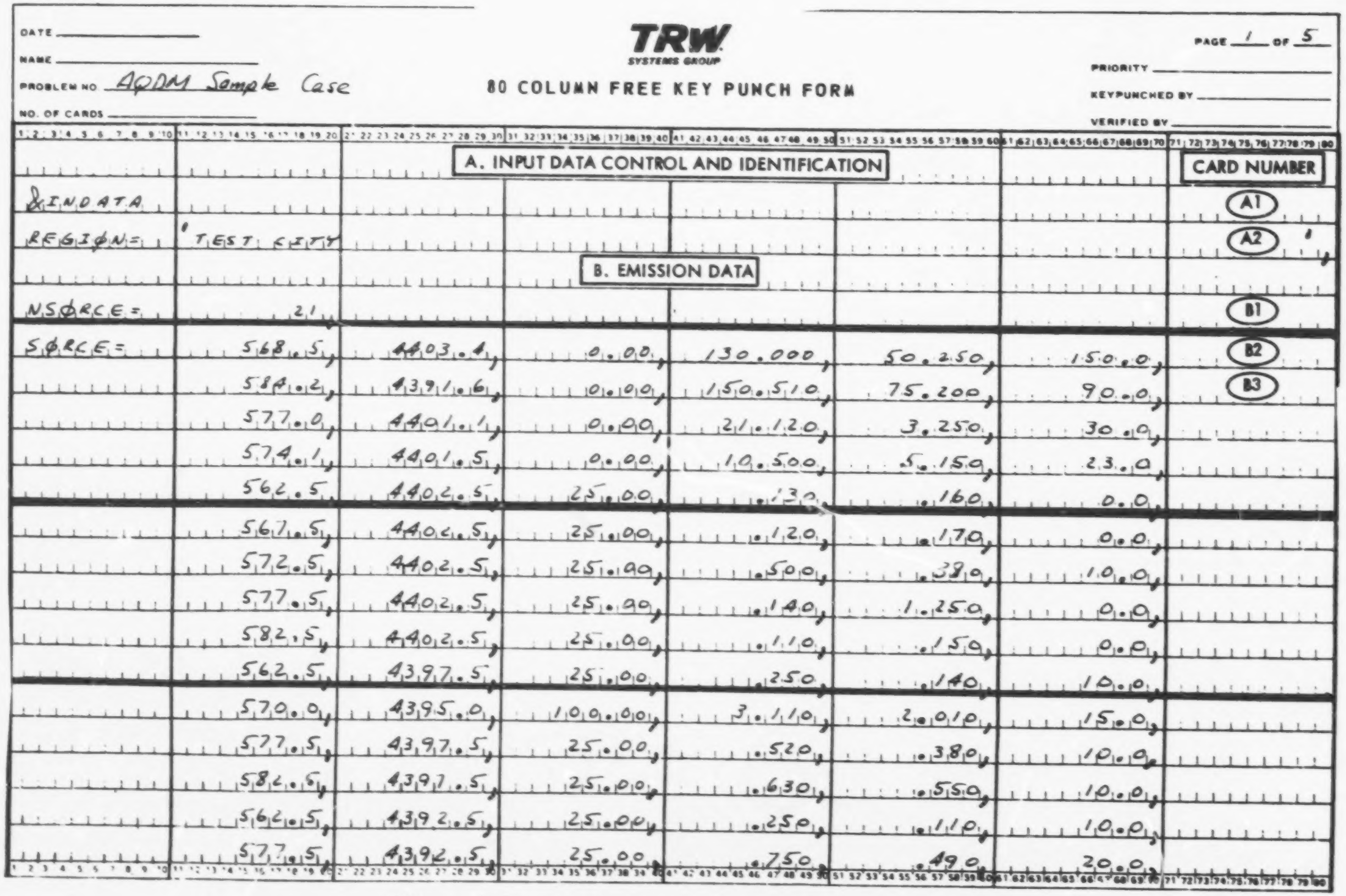

RECEPTORS SELECTED FOR SOURCE CONTRIBUTION OUTPUT, SECⒾ, PAGE 4-31
RECEPTORS SELECTED FOR STATISTICAL OUTPUT, SECⒽ, PAGE 4-27
NON-GRID RECEPTOR LOCATIONS, SEC Ⓖ, PAGE 4-25
GRID RECEPTOR PARAMETERS SEC Ⓕ, PAGE 4-23
PROGRAM OPTIONS, SECⒺ, PAGE 4-21
SAMPLING STATION DATA, SEC Ⓓ, PAGE 4-17
METEOROLOGICAL DATA, SECⒸ, PAGE 4-15
EMISSION INVENTORY SECⒷ, PAGE 4-13
INPUT DATA CONTROL AND IDENTIFICATION, SECⒶ, PAGE 4-11
&END
NSEL5 = 1,
NSEL12 = 1,
IADD = 12,
RBASE = 580., 4372.5,
IPUNCH = 0,
NSØ2 = 7,
WNDFRQ = .000000, .000000, .000000, ...
NSØRCE = 21,
REGIØN = 'TEST CITY',
&INDATA

Figure 4-1. AQDM Punched-Card Input Deck



DATE
NAME
PROBLEM NO. AQDM Sample Case
NO. OF CARDS

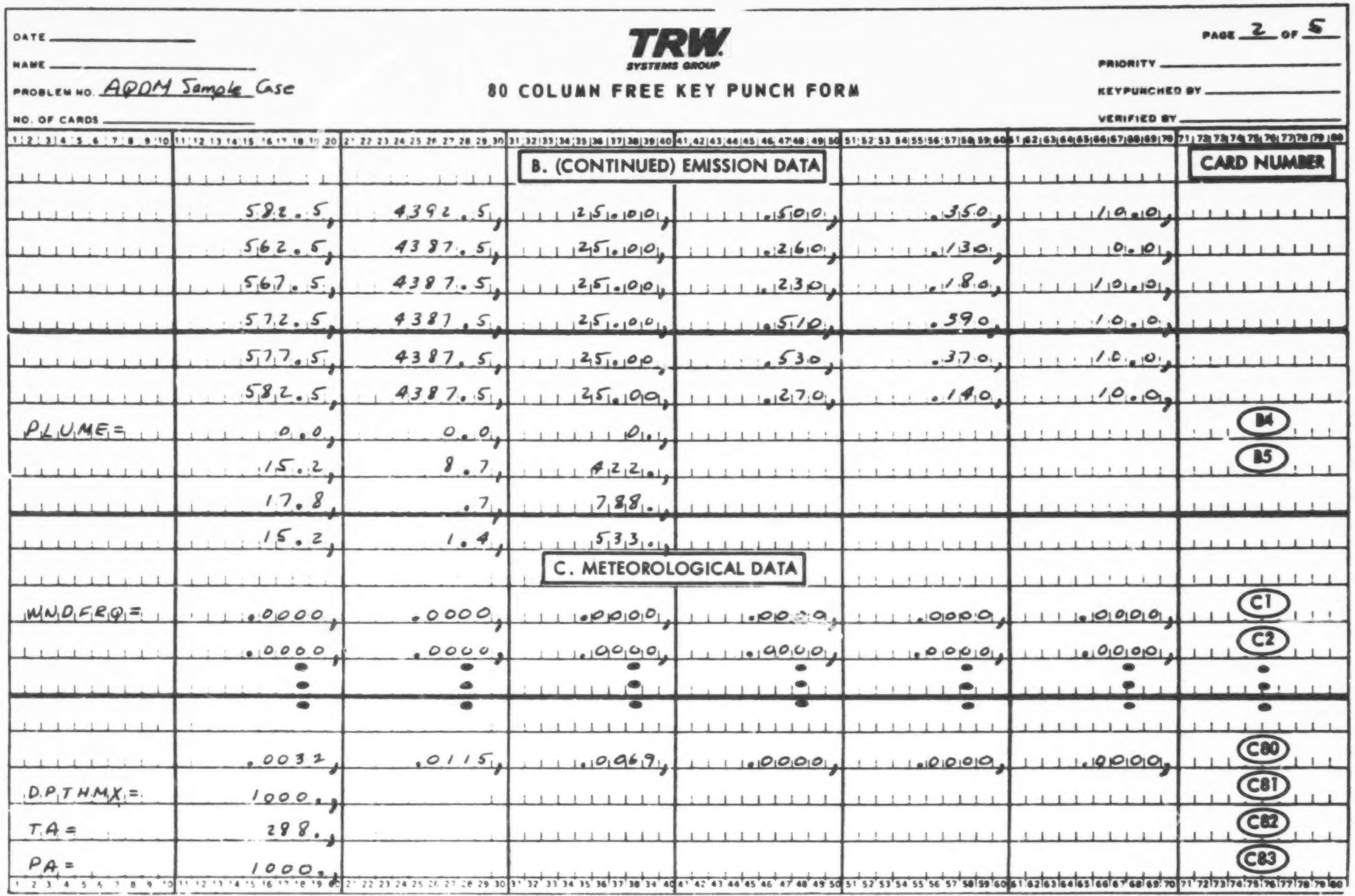
TRW SYSTEMS GROUP

80 COLUMN FREE KEY PUNCH FORM

PAGE 1 OF 5
PRIORITY
KEYPUNCHED BY
VERIFIED BY

1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
		A. INPUT DATA CONTROL AND IDENTIFICATION					CARD NUMBER
&INDATA							(A1)
REGIØN=	'TEST CITY						(A2) ',
			B. EMISSION DATA				
NSØRCE=	21,						(B1)
SØRCE=	568.5,	4403.4,	0.00,	130.000,	50.250,	150.0,	(B2)
	584.2,	4391.6,	0.00,	150.510,	75.200,	90.0,	(B3)
	577.0,	4401.1,	0.00,	21.120,	3.250,	30.0,	
	574.1,	4401.5,	0.00,	10.500,	5.150,	23.0,	
	562.5,	4402.5,	25.00,	.130,	.160,	0.0,	
	567.5,	4402.5,	25.00,	.120,	.170,	0.0,	
	572.5,	4402.5,	25.00,	.500,	.380,	10.0,	
	577.5,	4402.5,	25.00,	.140,	1.250,	0.0,	
	582.5,	4402.5,	25.00,	.110,	.150,	0.0,	
	562.5,	4397.5,	25.00,	.250,	.140,	10.0,	
	570.0,	4395.0,	100.00,	3.110,	2.010,	15.0,	
	577.5,	4397.5,	25.00,	.520,	.380,	10.0,	
	582.5,	4397.5,	25.00,	.630,	.550,	10.0,	
	562.5,	4392.5,	25.00,	.250,	.110,	10.0,	
	577.5,	4392.5,	25.00,	.750,	.490,	20.0,	

Figure 4-2. Completed Loadsheets for Sample Case



DATE ____
NAME ____
PROBLEM NO. AQDM Sample Case
NO. OF CARDS ____

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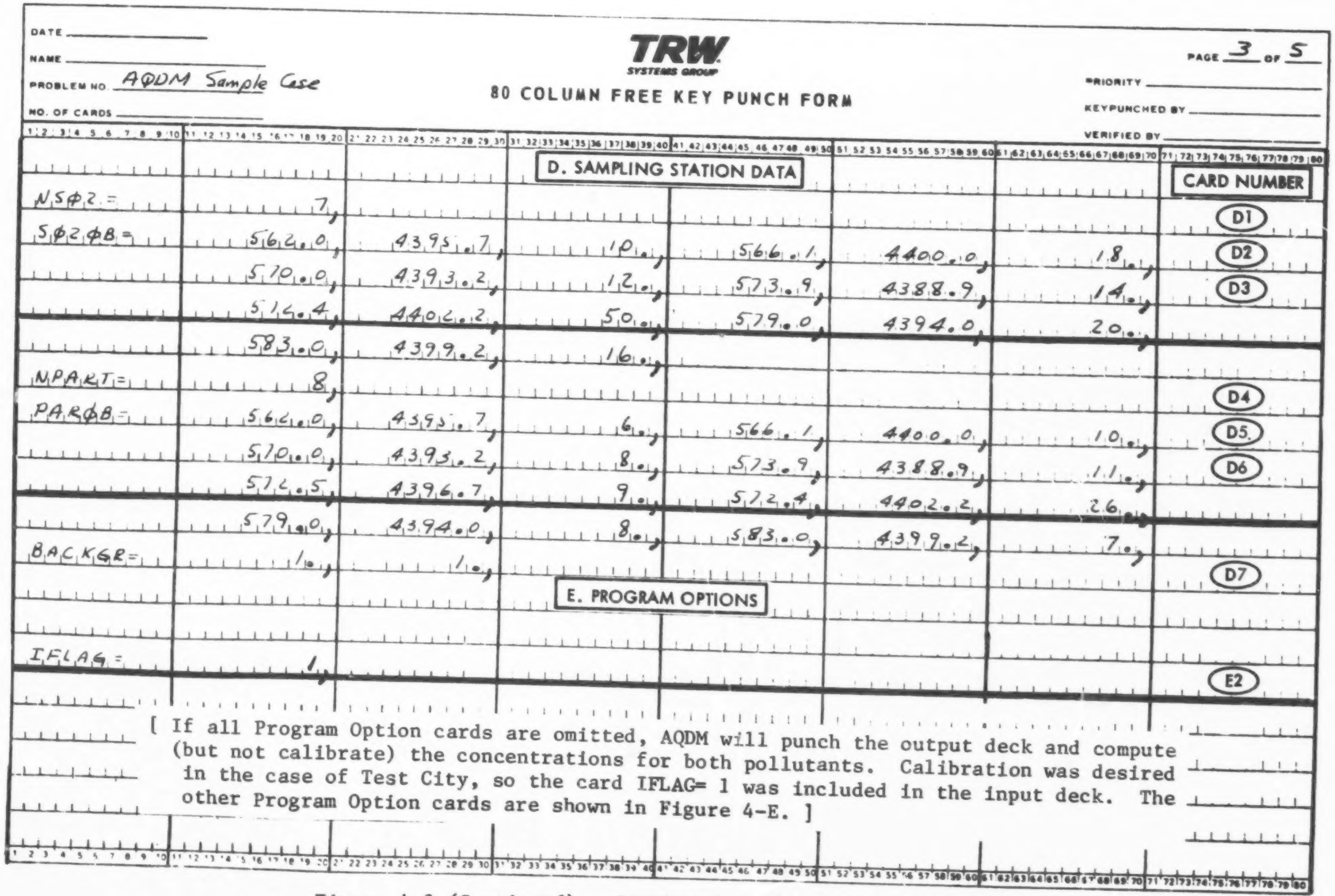
SYSTEMS GROUP
80 COLUMN FREE KEY PUNCH FORM

PAGE 2 OF 5
PRIORITY ____
KEYPUNCHED BY ____
VERIFIED BY ____

			B. (CONTINUED) EMISSION DATA				CARD NUMBER
	582.5,	4392.5,	25.00,	.500,	.350,	10.0,	
	562.5,	4387.5,	25.00,	.260,	.130,	0.0,	
	567.5,	4387.5,	25.00,	.230,	.180,	10.0,	
	572.5,	4387.5,	25.00,	.510,	.590,	10.0,	
	577.5,	4387.5,	25.00,	.530,	.370,	10.0,	
	582.5,	4387.5,	25.00,	.270,	.140,	10.0,	
PLUME=	0.0,	0.0,	0.,				B4
	15.2,	8.7,	422.,				B5
	17.8,	.7,	788.,				
	15.2,	1.4,	533.,				
			C. METEOROLOGICAL DATA				
WNDFRQ=	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	C1
	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	C2
	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	.0032,	.0115,	.0969,	.0000,	.0000,	.0000,	C80
DPTHMX=	1000.,						C81
TA=	288.,						C82
PA=	1000.,						C83

Figure 4-2 (Continued). Completed Loadsheets for Sample Case



DATE

NAME

PROBLEM NO. AQDM Sample Case

NO. OF CARDS

TRW SYSTEMS GROUP

80 COLUMN FREE KEY PUNCH FORM

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PRIORITY

KEYPUNCHED BY

VERIFIED BY

D. SAMPLING STATION DATA

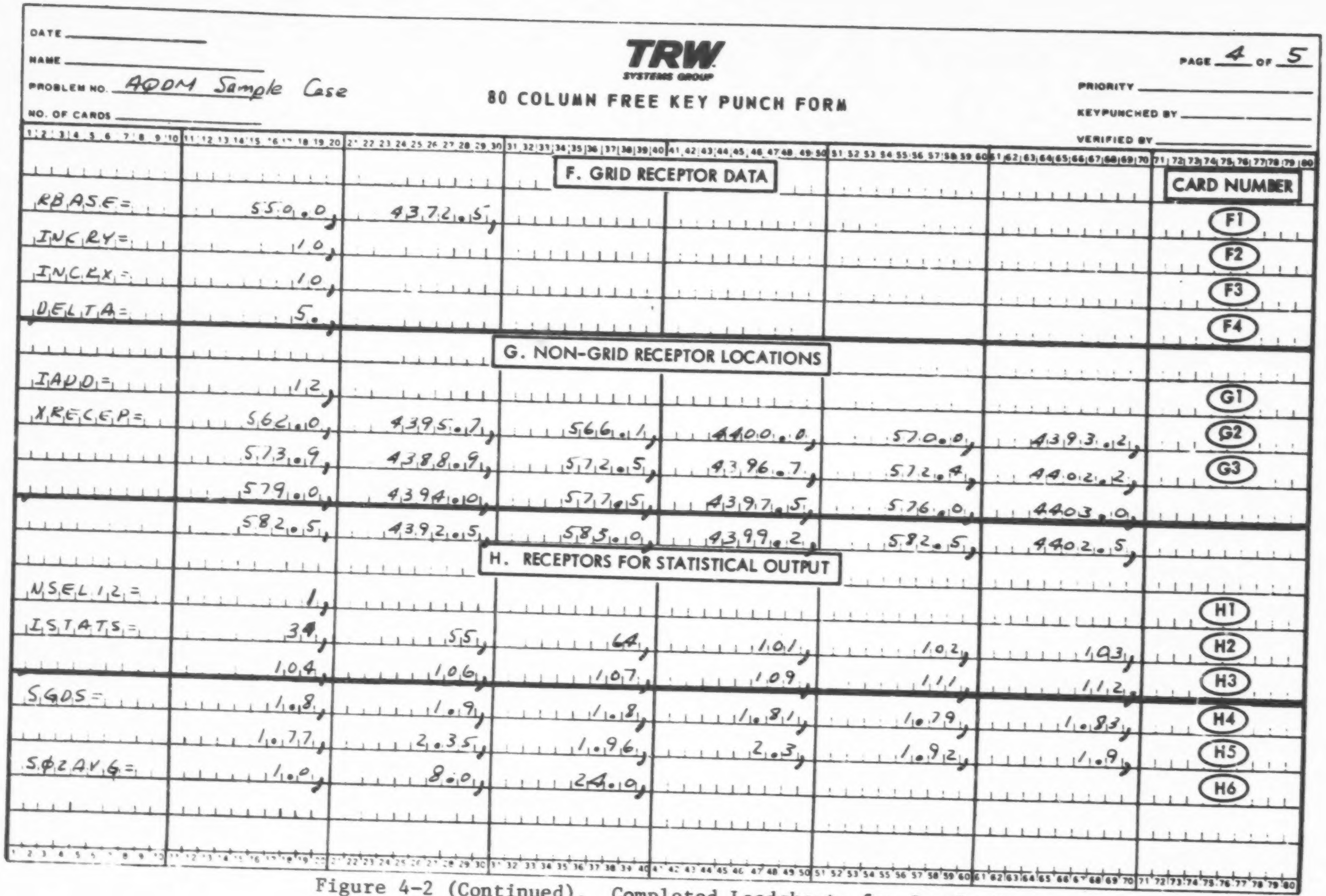
1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
							CARD NUMBER
NSØ2=	7,						D1
SØ2ØB=	562.0,	4395.7,	10.,	566.1,	4400.0,	18.,	D2
	570.0,	4393.2,	12.,	573.9,	4388.9,	14.,	D3
	576.4,	4402.2,	50.,	579.0,	4394.0,	20.,	
	583.0,	4399.2,	16.,				
NPAKT=	8,						D4
PARØB=	562.0,	4395.7,	6.,	566.1,	4400.0,	10.,	D5
	570.0,	4393.2,	8.,	573.9,	4388.9,	11.,	D6
	572.5,	4396.7,	9.,	572.4,	4402.2,	26.,	
	579.0,	4394.0,	8.,	583.0,	4399.2,	7.,	
BACKGR=	1.,	1.,					D7

E. PROGRAM OPTIONS

1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
IFLAG=	1,						E2

[If all Program Option cards are omitted, AQDM will punch the output deck and compute (but not calibrate) the concentrations for both pollutants. Calibration was desired in the case of Test City, so the card IFLAG= 1 was included in the input deck. The other Program Option cards are shown in Figure 4-E.]

Figure 4-2 (Continued). Completed Loadsheets for Sample Case



DATE

NAME

PROBLEM NO. AQDM Sample Case

NO. OF CARDS

TRW SYSTEMS GROUP

80 COLUMN FREE KEY PUNCH FORM

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PRIORITY

KEYPUNCHED BY

VERIFIED BY

			F. GRID RECEPTOR DATA				CARD NUMBER
RBASE=	550.0,	4372.5,					F1
INCRY=	10,						F2
INCLX=	10,						F3
DELTA=	5.						F4
			G. NON-GRID RECEPTOR LOCATIONS				
IADD=	12,						G1
XRECEP=	562.0,	4395.7,	566.1,	4400.0,	570.0,	4393.2,	G2
	573.9,	4388.9,	572.5,	4396.7,	572.4,	4402.2,	G3
	579.0,	4394.0,	577.5,	4397.5,	576.0,	4403.0,	
	582.5,	4392.5,	585.0,	4399.2,	582.5,	4402.5,	
			H. RECEPTORS FOR STATISTICAL OUTPUT				
NSELI2=	1,						H1
ISTATS=	34,	55,	64,	101,	102,	103,	H2
	104,	106,	107,	109,	111,	112,	H3
SGDS=	1.8,	1.9,	1.8,	1.81,	1.79,	1.83,	H4
	1.77,	2.35,	1.96,	2.3,	1.92,	1.9,	H5
SØZAVG=	1.0,	8.0,	24.0,				H6

Figure 4-2 (Continued). Completed Loadsheets for Sample Case

DATE ____
NAME ____
PROBLEM NO AQUM Sample Case
NO. OF CARDS ____

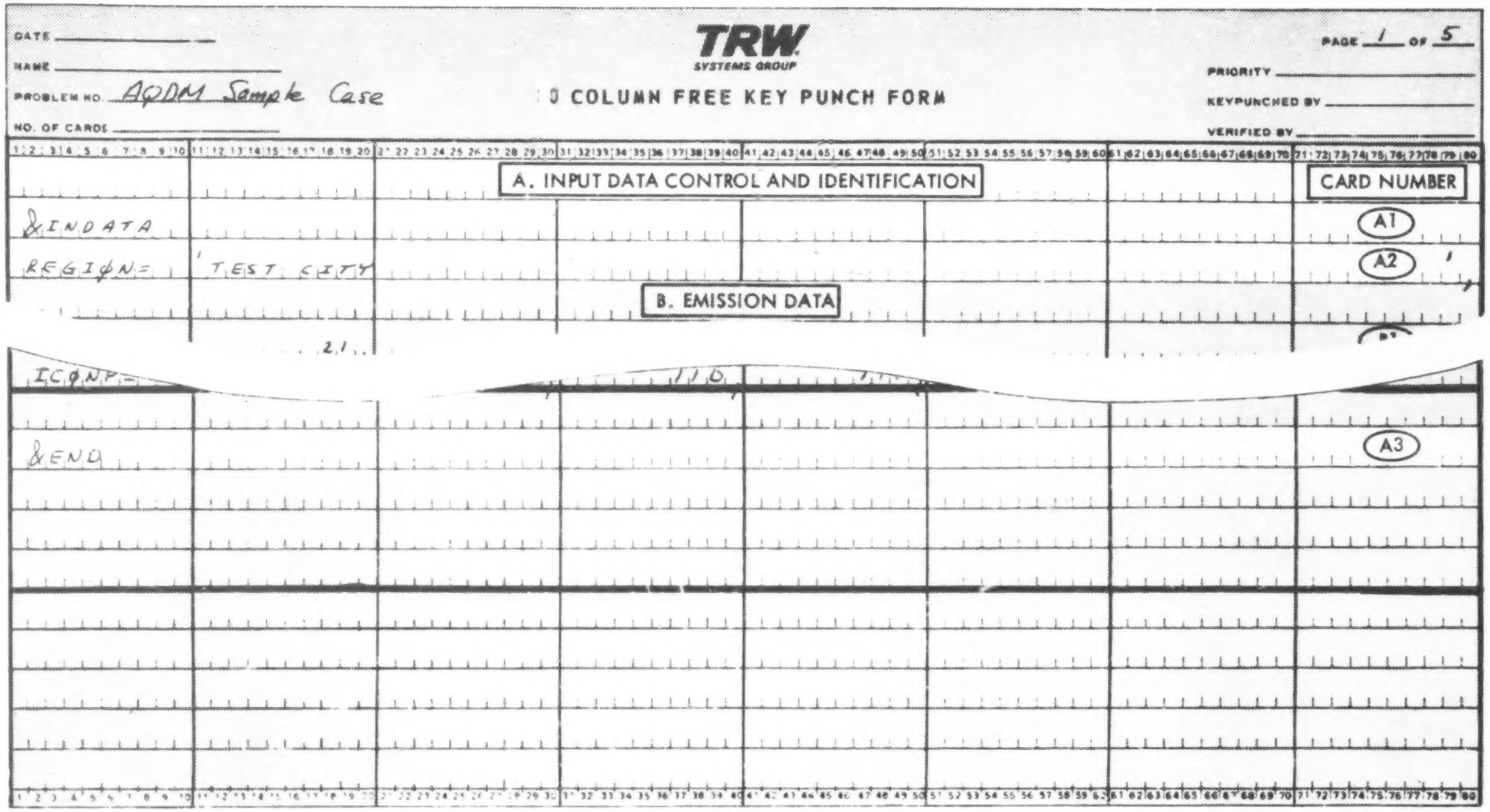
TRW
SYSTEMS GROUP

80 COLUMN FREE KEY PUNCH FORM

PAGE 5 OF 5
PRIORITY ____
KEYPUNCHED BY ____
VERIFIED BY ____

			H. (CONTINUED) RECEPTORS FOR STATISTICAL OUTPUT				CARD NUMBER
ISTATP=	55,	64,	101,	102,	103,	104,	H7
	105,	106,	107,	109,	111,	112,	H8
SGOP=	1.7,	1.7,	1.70,	1.67,	1.72,	1.65,	H9
	1.72,	2.01,	1.82,	2.0,	1.80,	1.8,	H10
PARAVG=	4.0,	8.0,	24.0,				H11
			I. RECEPTORS FOR SOURCE CONTRIBUTION OUTPUT				
NSELS=	1,						I1
ICØNS=	46,	55,	109,	110,	111,		I2
ICØNP=	105,	109,	110,	111,	112,		I3
&END							A3

Figure 4-2 (Continued). Completed Loadsheets for Sample Case



TRW
SYSTEMS GROUP

0 COLUMN FREE KEY PUNCH FORM

DATE
NAME
PROBLEM NO. AQDM Sample Case
NO. OF CARDS

PAGE 1 OF 5
PRIORITY
KEYPUNCHED BY
VERIFIED BY

A. INPUT DATA CONTROL AND IDENTIFICATION

CARD NUMBER

&INDATA (A1)

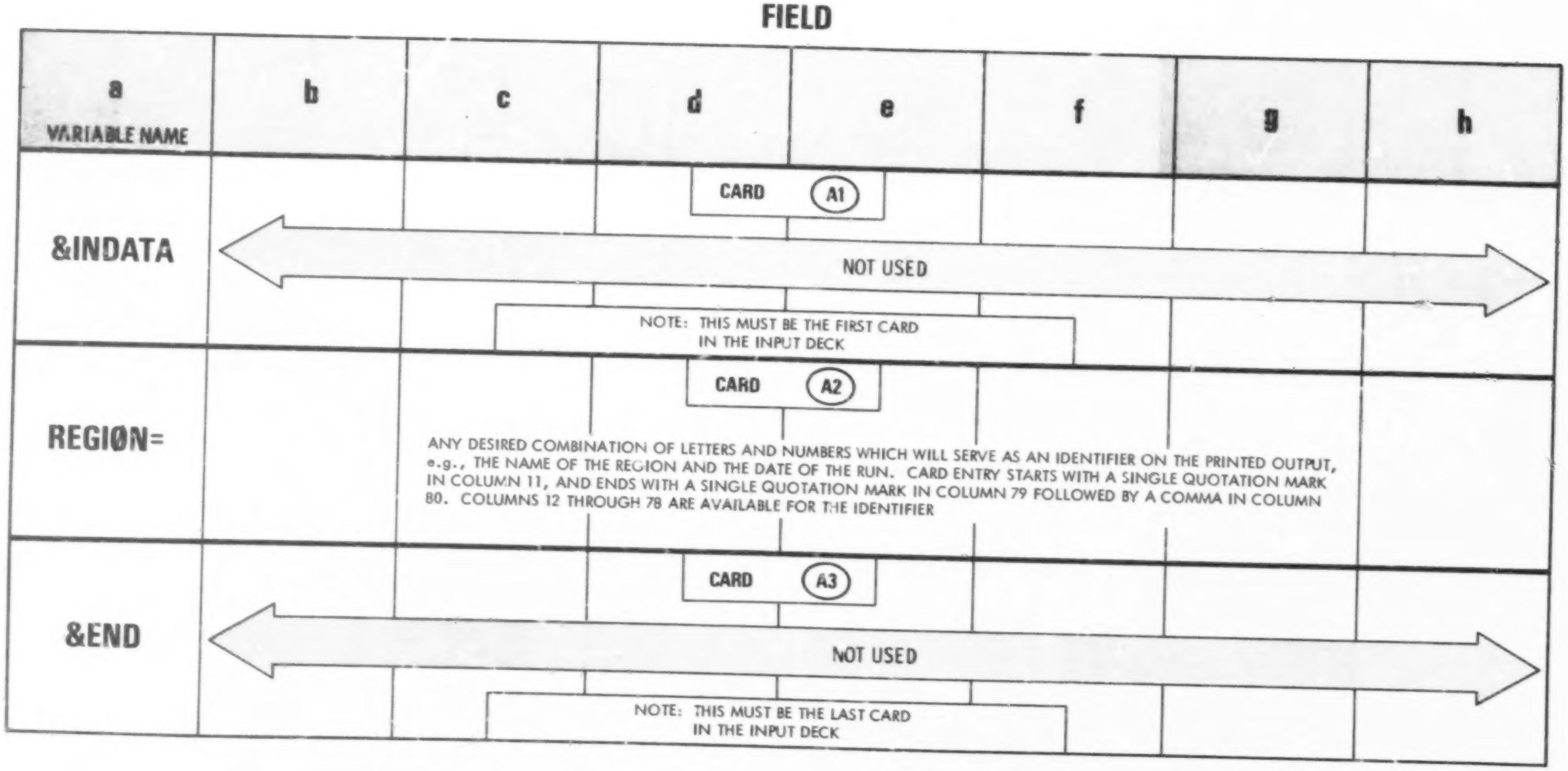
REGION= 'TEST CITY' (A2)

B. EMISSION DATA

2,1

ICONP= 1,1,0,

&END (A3)



NOTE: THIS MUST BE THE FIRST CARD IN THE INPUT DECK

ANY DESIRED COMBINATION OF LETTERS AND NUMBERS WHICH WILL SERVE AS AN IDENTIFIER ON THE PRINTED OUTPUT, e.g., THE NAME OF THE REGION AND THE DATE OF THE RUN. CARD ENTRY STARTS WITH A SINGLE QUOTATION MARK IN COLUMN 11, AND ENDS WITH A SINGLE QUOTATION MARK IN COLUMN 79 FOLLOWED BY A COMMA IN COLUMN 80. COLUMNS 12 THROUGH 78 ARE AVAILABLE FOR THE IDENTIFIER

NOTE: THIS MUST BE THE LAST CARD IN THE INPUT DECK

Figure 4-A. Input Data Control and Identification

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DATE
NAME
PROBLEM NO. AQDM Sample Case
NO. OF CARDS

PAGE 1 OF 5
PRIORITY
KEYPUNCHED BY
VERIFIED BY

		A. INPUT DATA CONTROL AND IDENTIFICATION					CARD NUMBER
&INDATA							A1
REGION=	'TEST CITY						A2 ',
			B. EMISSION DATA				
NSØRCE=	21,						B1
SØRCE=	568.5,	4403.4,	0.00,	130.000,	50.250,	150.0,	B2
	584.2,	4391.6,	0.00,	150.510,	75.200,	90.0,	B3
	577.0,	4401.1,	0.00,		3.250,	30.0,	
	577.3,		.0,	.530,	.370,	23.0,	
	582.5,	4387.5,	25.00,	.270,	.140,		
PLUME=	0.0,	0.0,	0.,				B4
	15.2,	8.7,	422.,				B5
	17.8	.7,	788.,				
	15.2,	1.4,	533.,				
			C. METEOROLOGICAL DATA				
WNDFRQ=	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	C1
	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	C2
	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	.0032,	.0115,	.0069,	.0000,	.000,	.0000,	C80
DPTHMX=	1000.,						C81
TA=	288.,						C82
PA=	1000.,						C83

FIELD

a VARIABLE NAME	b	c	d	e	f	g	h
			CARD B1				
NSØRCE=	NUMBER OF SOURCES TO BE USED (NO DECIMAL POINT; RIGHT-JUSTIFIED)	NOT USED					
			CARD B2				
SØRCE=	X (HORIZONTAL) COORDINATE OF SOURCE 1, KILOMETERS	Y (VERTICAL) COORDINATE OF SOURCE 1, KILOMETERS	AREA OF SOURCE 1, KILOMETERS^2	ANNUAL AVERAGE SO_2 EMISSION RATE, SOURCE 1, TONS/DAY	ANNUAL AVERAGE PARTICULATE EMISSION RATE, SOURCE 1, TONS/DAY	PHYSICAL STACK HEIGHT, SOURCE 1, METERS	NOT USED
			CARD B3				
NOT USED	X (HORIZONTAL) COORDINATE OF SOURCE N, KILOMETERS	Y (VERTICAL) COORDINATE OF SOURCE N, KILOMETERS	AREA OF SOURCE N, KILOMETERS^2	ANNUAL AVERAGE SO_2 EMISSION RATE, SOURCE N, TONS/DAY	ANNUAL AVERAGE PARTICULATE EMISSION RATE, SOURCE N, TONS/DAY	PHYSICAL STACK HEIGHT, SOURCE N, METERS	NOT USED
		NOTE: THIS CARD IS REPEATED AS REQUIRED (UP TO A MAXIMUM OF 999 CARDS) TO INPUT ALL SOURCE DATA.					
			CARD B4				
PLUME=	STACK EXIT VELOCITY, SOURCE 1, METERS/SECOND	STACK DIAMETER, SOURCE 1, METERS	STACK EXHAUST TEMPERATURE, SOURCE 1, DEGREES, KELVIN	NOT USED			
			CARD B5				
NOT USED	STACK EXIT VELOCITY, SOURCE N, METERS/SECOND	STACK DIAMETER, SOURCE N, METERS	STACK EXHAUST TEMPERATURE, SOURCE N, DEGREES, KELVIN	NOT USED			
		NOTE: THIS CARD IS REPEATED AS REQUIRED (UP TO A MAXIMUM 999 CARDS) TO INPUT ALL PLUME RISE DATA					

Figure 4-B. Emission Inventory

TRW
SYSTEMS GROUP

80 COLUMN FREE KEY PUNCH FORM

DATE
NAME
PROBLEM NO. AQDM Sample Case
NO. OF CARDS

PAGE 2 OF 5
PRIORITY
KEYPUNCHED BY
VERIFIED BY

			B. (CONTINUED) EMISSION DATA				**CARD NUMBER**
	582.5,	4392.5,	25.00,	.500,	.350,	10.0,	
	562.5,	4387.5,	25.00,	.260,	.130,	0.0,	
	567.5,	4387.5,	25.00,	.230,	.180,	10.0,	
	572.5,	4387.5,	25.00,	.510,	.590,	10.0,	
	577.5,	4387.5,	25.00,	.530,	.370,	10.0,	
	582.5,	4387.5,	25.00,	.270,	.140,	10.0,	
PLUME=	0.0,	0.0,	0.,				(B4)
	15.2,	8.7,	422.,				(B5)
	17.8,	.7,	788.,				
	15.2,	1.4,	533.,				
			C. METEOROLOGICAL DATA				
WNDFRQ=	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	(C1)
	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	(C2)
	⋮	⋮	⋮	⋮	⋮	⋮	⋮
	.0032,	.0115,	.0069,	.0000,	.0000,	.0000,	(C80)
DPTHMX=	1000.,						(C81)
TA=	288.,						(C82)
PA=	1000.						(C83)

FIELD

a Variable Name	b	c	d	e	f	g	h
			CARD C1				
WNDFRQ=	WIND FREQUENCY FOR STABILITY CLASS 1, DIRECTION 1, SPEED CLASS 1	WIND FREQUENCY FOR STABILITY CLASS 1, DIRECTION 1, SPEED CLASS 2	WIND FREQUENCY FOR STABILITY CLASS 1, DIRECTION 1, SPEED CLASS 3	WIND FREQUENCY FOR STABILITY CLASS 1, DIRECTION 1, SPEED CLASS 4	WIND FREQUENCY FOR STABILITY CLASS 1, DIRECTION 1, SPEED CLASS 5	WIND FREQUENCY FOR STABILITY CLASS 1, DIRECTION 1, SPEED CLASS 6	Not Used
			CARDS C2 - C80				
Not Used	WIND FREQUENCY FOR STABILITY CLASS N, DIRECTION M, SPEED CLASS 1	WIND FREQUENCY FOR STABILITY CLASS N, DIRECTION M, SPEED CLASS 2	WIND FREQUENCY FOR STABILITY CLASS N, DIRECTION M, SPEED CLASS 3	WIND FREQUENCY FOR STABILITY CLASS N, DIRECTION M, SPEED CLASS 4	WIND FREQUENCY FOR STABILITY CLASS N, DIRECTION M, SPEED CLASS 5	WIND FREQUENCY FOR STABILITY CLASS N, DIRECTION M, SPEED CLASS 6	Not Used
			CARD C81				
DPTHMX=	MIXING DEPTH, METERS	Not Used					
			CARD C82				
TA=	AMBIENT TEMPERATURE, DEGREES KELVIN	Not Used					
			CARD C83				
PA=	AMBIENT PRESSURE, MILLIBARS	Not Used					

NOTE: A SET OF 16 CARDS IS REQUIRED TO DESCRIBE THE WIND ROSE (THE 16 WIND DIRECTIONS) FOR EACH STABILITY CLASS, I.E., CARDS 1-16 DESCRIBE THE WIND ROSE FOR STABILITY CLASS 1; CARDS 17-32 DESCRIBE THE WIND ROSE FOR STABILITY CLASS 2, ETC.

Figure 4-C. Meteorological Data

DATE ____________
NAME ____________
PROBLEN NO. AQDM Sample Case
NO. OF CARDS ____________

TRW
SYSTEMS GROUP

80 COLUMN FREE KEY PUNCH FORM

PAGE 3 OF 5
PRIORITY ____________
KEYPUNCHED BY ____________
VERIFIED BY ____________

			D. SAMPLING STATION DATA				CARD NUMBER
NSO2 =	7,						D1
SO2OB =	562.0,	4395.7,	10.,	566.1,	4400.0,	18.,	D2
	570.0,	4393.2,	12.,	573.9,	4388.9,	14.,	D3
	572.4,	4402.2,	50.,	579.0,	4394.0,	20.,	
	583.0,	4399.2,	16.,				
NPART =	8,						D4
PAROB =	562.0,	4395.7,	6.,	566.1,	4400.0,	10.,	D5
	570.0,	4393.2,	8.,	573.9,	4388.9,	11.,	D6
	572.5,	4396.7,	9.,	572.4,	4402.2,	26.,	
	579.0,	4394.0,	8.,	583.0,	4399.2,	7.,	
BACKGR =	1.,	1.,					D7
			E. PROGRAM OPTIONS				
IPUNCH =	1,				(NOT USED IN SAMPLE CASE)		E1
IFLAG =	1,						E2
SO2CAL =	nn.n,	n.nn,			(NOT USED IN SAMPLE CASE)		E3
PARCAL =	nn.n,	n.nn,			(NOT USED IN SAMPLE CASE)		E4
MPOLUT =	1,				(NOT USED IN SAMPLE CASE)		E5

FIELD

a VARIABLE NAME	b	c	d	e	f	g	h
NS02=	NUMBER OF SO_2 MEASURING STATIONS TO BE USED IN CALIBRATION (NO DECIMAL; RIGHT-JUSTIFIED)	NOT USED	CARD D1				
S020B=	X (HORIZONTAL) COORDINATE, SO_2 SAMPLING STATION 1, KILOMETERS	Y (VERTICAL) COORDINATE, SO_2 SAMPLING STATION 1, KILOMETERS	CARD D2 MEASURED VALUE OF ANNUAL ARITHMETIC MEAN SO_2 CONCENTRATION, SAMPLING STATION 1, MICROGRAMS/$METER^3$	X, SO_2 SAMPLING STATION 2	Y, SO_2 SAMPLING STATION 2	SO_2 MEASUREMENT, SAMPLING STATION 2	NOT USED
NOT USED	X (HORIZONTAL) COORDINATE, SO_2 SAMPLING STATION N, KILOMETERS	Y (VERTICAL) COORDINATE, SO_2 SAMPLING STATION N, KILOMETERS	CARD D3 MEASURED VALUE OF ANNUAL ARITHMETIC MEAN SO_2 CONCENTRATION, SAMPLING STATION N, MICROGRAMS/$METER^3$	X, SO_2 SAMPLING STATION N + 1	Y, SO_2 SAMPLING STATION N + 1	SO_2 MEASUREMENT, SAMPLING STATION N + 1	NOT USED

NOTE: THIS CARD IS REPEATED AS REQUIRED (UP TO A MAXIMUM OF 49 CARDS) TO INPUT ALL SO_2 MEASUREMENTS

Figure 4-D. Sampling Station Data

DATE
NAME
PROBLEM NO. AQDM Sample Case
NO. OF CARDS

TRW SYSTEMS GROUP

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PRIORITY
KEYPUNCHED BY
VERIFIED BY

1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
			D. SAMPLING STATION DATA				CARD NUMBER
NS02=	7,						D1
S020B=	562.0,	4395.7,	10.,	566.1,	4400.0,	18.,	D2
	570.0,	4393.2,	12.,	573.9,	4388.9,	14.,	D3
	572.4,	4402.2,	50.,	579.0,	4394.0,	20.,	
	583.0,	4399.2,	16.,				
NPART=	8,						D4
PAR0B=	562.0,	4395.7,	6.,	566.1,	4400.0,	10.,	D5
	570.0,	4393.2,	8.,	573.9,	4388.9,	11.,	D6
	572.5,	4396.7,	9.,	572.4,	4402.2,	26.,	
	579.0,	4394.0,	8.,	583.0,	4399.2,	7.,	
BACKGR=	1.,	1.,					D7
			E. PROGRAM OPTIONS				
IPUNCH=	1,				(NOT USED IN SAMPLE CASE)		E1
IFLAG=	1						E2
S02CAL=	nn.n,	n.nn,			(NOT USED IN SAMPLE CASE)		E3
PARCAL=	nn.n,	n.nn,			(NOT USED IN SAMPLE CASE)		E4
MP0LUT=	1,				(NOT USED IN SAMPLE CASE)		E5

FIELD

a VARABLE NAME	b	c	d	e	f	g	h
NPART=	NUMBER OF PARTICULATE MEASURING STATIONS TO BE USED IN CALIBRATION (NO DECIMAL; RIGHT-JUSTIFIED)	NOT USED	CARD D4				
PARØB=	X (HORIZONTAL) COORDINATE, PARTICULATE SAMPLING STATION 1, KILOMETERS	Y (VERTICAL) COORDINATE PARTICULATE SAMPLING STATION 1, KILOMETERS	CARD D5 MEASURED VALUE OF ANNUAL ARITHMETIC MEAN PARTICULATE CONCENTRATION, PARTICULATE SAMPLING STATION 1, MICROGRAMS/METER^3	X, PARTICULATE SAMPLING STATION 2	Y, PARTICULATE SAMPLING STATION 2	PARTICULATE MEASUREMENT, STATION 2	NOT USED
NOT USED	X (HORIZONTAL) COORDINATE, PARTICULATE SAMPLING STATION N, KILOMETERS	Y (VERTICAL) COORDINATE, PARTICULATE SAMPLING STATION N, KILOMETERS	CARD D6 MEASURED VALUE OF ANNUAL ARITHMETIC MEAN PARTICULATE CONCENTRATION, PARTICULATE SAMPLING STATION N, MICROGRAMS/METER^3	X, PARTICULATE SAMPLING STATION N + 1	Y, PARTICULATE SAMPLING STATION N + 1 NOTE: THIS CARD IS REPEATED AS REQUIRED (UP TO A MAXIMUM OF 49 CARDS) TO INPUT ALL PARTICULATE MEASUREMENTS	PARTICULATE MEASUREMENT, STATION N + 1	NOT USED
BACKGR=	SO_2 BACKGROUND CONCENTRATION, ANNUAL ARITHMETIC MEAN, MICROGRAMS/METER^3	PARTICULATE BACKGROUND CONCENTRATION ANNUAL ARITHMETIC MEAN, MICROGRAMS/METER^3	CARD D7 NOT USED				

Figure 4-D (Continued). Sampling Station Data

DATE ____

NAME ____

PROBLEM NO. AQDM Sample Case

NO. OF CARDS ____

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SYSTEMS GROUP

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PRIORITY ____

KEYPUNCHED BY ____

VERIFIED BY ____

			D. SAMPLING STATION DATA				CARD NUMBER
NS02 =	7,						Ⓓ1
S020B =	562.0,	4395.7,	10.,	566.1,	4400.0,	18.,	Ⓓ2
	570.0,	4393.2,	12.,	573.9,	4388.9,	14.,	Ⓓ3
	512.4,	4402.2,	50.,	579.0,	4394.0,	20.,	
	583.0,	4399.2,	16.,				
NPAKT =	8,						Ⓓ4
PAR0B =	562.0,	4395.7,	6.,	566.1,	4400.0,	10.,	Ⓓ5
	570.0,	4393.2,	8.,	573.9,	4388.9,	11.,	Ⓓ6
	572.5,	4396.7,	9.,	572.4,	4402.2,	26.,	
	579.0,	4394.0,	8.,	583.0,	4399.2,	7.,	
BACKGR =	1.,	1.,					Ⓓ7
			E. PROGRAM OPTIONS				
IPUNCH =	1,				(NOT USED IN SAMPLE CASE)		Ⓔ1
IFLAG =	1,						Ⓔ2
S02CAL =	nn.n,	n.nn,			(NOT USED IN SAMPLE CASE)		Ⓔ3
PARCAL =	nn.n,	n.nn,			(NOT USED IN SAMPLE CASE)		Ⓔ4
MP0LUT =	1,				(NOT USED IN SAMPLE CASE)		Ⓔ5

FIELD							
a VARIABLE NAME	b	c	d	e	f	g	h
IPUNCH=	SET TO 1 (NO DECIMAL; RIGHT JUSTIFIED) IF DECK FOR MAPS IS NOT TO BE PUNCHED. IF OMITTED, PROGRAM WILL PUNCH DECK	NOT USED	CARD E1				
IFLAG=	SET TO 1 FOR CALIBRATE AND COMPUTE, 2 FOR CALIBRATE ONLY (NO DECIMAL; RIGHT JUSTIFIED). IF OMITTED, CONCENTRATIONS COMPUTED AND ADJUSTED IF CARDS E3 AND E4 ARE INPUT	NOT USED	CARD E2				
S02CAL=	SO$_2$ REGRESSION LINE Y - AXIS INTERCEPT, MICROGRAMS/METER^3	SLOPE OF SO$_2$ REGRESSION LINE, DIMENSIONLESS	CARD E3 NOT USED				
PARCAL=	PARTICULATE REGRESSION LINE Y - AXIS INTERCEPT, MICROGRAMS/METER^3	SLOPE OF PARTICULATE REGRESSION LINE, DIMENSIONLESS	CARD E4 NOT USED				
NP0LUT=	SET TO 1 FOR SO$_2$ ONLY; 2 FOR PARTICULATES ONLY (NO DECIMAL; RIGHT JUSTIFIED). IF OMITTED, PROGRAM WILL INCLUDE BOTH POLLUTANTS	NOT USED	CARD E5				

Figure 4-E. Program Options

DATE ____
NAME ____
PROBLEM NO. AQDM Sample Case
NO. OF CARDS ____

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PRIORITY ____
KEYPUNCHED BY ____
VERIFIED BY ____

1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
			F. GRID RECEPTOR DATA				CARD NUMBER
RBASE=	550.0,	4372.5,					F1
INCRY=	10,						F2
INCRX=	10,						F3
DELTA=	5.,						F4
			G. NON-GRID RECEPTOR LOCATIONS				
IADD=	12,						G1
YRECEP=	562.0,	4395.7,	566.1,	4400.0,	570.0,	4393.2,	G2
	573.9,	4388.9,	572.5,	4396.7,	572.4,	4402.2,	G3
	579.0,	4394.0,	577.5,	4397.5,	576.0,	4403.0,	
	582.5,	4372.5,	583.0,	4399.2,	582.5,	4402.5,	
			H. RECEPTORS FOR STATISTICAL OUTPUT				
NSELI2=	1,						H1
ISTATS=	34,	55,	64,	101,	102,	103,	H2
	104,	106,	107,	109,	111,	112,	H3
SGDS=	1.8,	1.9,	1.8,	1.81,	1.79,	1.83,	H4
	1.77,	2.35,	1.96,	2.3,	1.92,	1.9,	H5
SØZAVG=	1.0,	8.0,	24.0,				H6

FIELD

a VARIABLE NAME	b	c	d	e	f	g	h
RBASE=	X (HORIZONTAL) COORDINATE OF GRID ORIGIN, KILOMETERS	Y (VERTICAL) COORDINATE OF GRID ORIGIN, KILOMETERS	CARD (F1) NOT USED				
INCRY=	NUMBER OF ROWS OF GRID RECEPTORS (NO DECIMAL; RIGHT-JUSTIFIED)	NOT USED	CARD (F2)				
INCRX=	NUMBER OF COLUMNS OF GRID RECEPTORS (NO DECIMAL; RIGHT-JUSTIFIED)	NOT USED	CARD (F3)				
DELTA=	SPACING BETWEEN ROWS AND COLUMNS (KILOMETERS)	NOT USED	CARD (F4)				

Figure 4-F. Grid Receptor Parameters

DATE

NAME

PROBLEM NO. AQDM Sample Case

NO. OF CARDS

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PRIORITY

KEYPUNCHED BY

VERIFIED BY

1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
			F. GRID RECEPTOR DATA				CARD NUMBER
RBASE=	550.0,	4372.5,					F1
INCRY=	1.0,						F2
INCRX=	1.0,						F3
DELTA=	5.,						F4
			G. NON-GRID RECEPTOR LOCATIONS				
IADD=	12,						G1
XRECEP=	562.0,	4395.7,	566.1,	4400.0,	570.0,	4393.2,	G2
	573.9,	4388.9,	572.5,	4396.7,	572.4,	4402.2,	G3
	579.0,	4394.0,	577.5,	4397.5,	576.0,	4403.0,	
	582.5,	4392.5,	585.0,	4399.2,	582.5,	4402.5,	
			H. RECEPTORS FOR STATISTICAL OUTPUT				
NSEL12=	1,						H1
ISTATS=	34,	55,	64,	101,	102,	103,	H2
	104,	106,	107,	109,	111,	112,	H3
SGDS=	1.8,	1.9,	1.8,	1.81,	1.79,	1.83,	H4
	1.77,	2.35,	1.96,	2.3,	1.92,	1.9,	H5
SØZAVG=	1.0,	8.0,	24.0,				H6

FIELD

a VARIABLE NAME	b	c	d	e	f	g	h
			CARD	G1			
IADD=	NUMBER OF NON-GRID RECEPTORS (NO DECIMAL; RIGHT-JUSTIFIED). IF OMITTED, PROGRAM ASSUMES NUMBER OF NON-GRID RECEPTORS IS ZERO	NOT USED					
			CARD	G2			
XRECEP=	X (HORIZONTAL) COORDINATE OF FIRST NON-GRID RECEPTOR, KILOMETERS	Y (VERTICAL) COORDINATE OF FIRST NON-GRID RECEPTOR, KILOMETERS	X, SECOND NON-GRID RECEPTOR	Y, SECOND NON-GRID RECEPTOR	X, THIRD NON-GRID RECEPTOR	Y, THIRD NON-GRID RECEPTOR	NOT USED
			CARD	G3			
NOT USED	X (HORIZONTAL) COORDINATE OF NTH NON-GRID RECEPTOR, KILOMETERS	Y (VERTICAL) COORDINATE OF NTH NON-GRID, RECEPTOR, KILOMETERS	X, N + 1ST NON-GRID RECEPTOR	Y, N + 1ST NON-GRID RECEPTOR	X, N + 2ND NON-GRID RECEPTOR	Y, N + 2ND NON-GRID RECEPTOR	NOT USED

NOTE: THIS CARD IS REPEATED AS REQUIRED UP TO A MAXIMUM OF THREE CARDS TO INPUT ALL NON-GRID RECEPTOR LOCATIONS

Figure 4-G. Non-Grid Receptor Locations

DATE
NAME
PROBLEM NO. AQDM Sample Case
NO. OF CARDS

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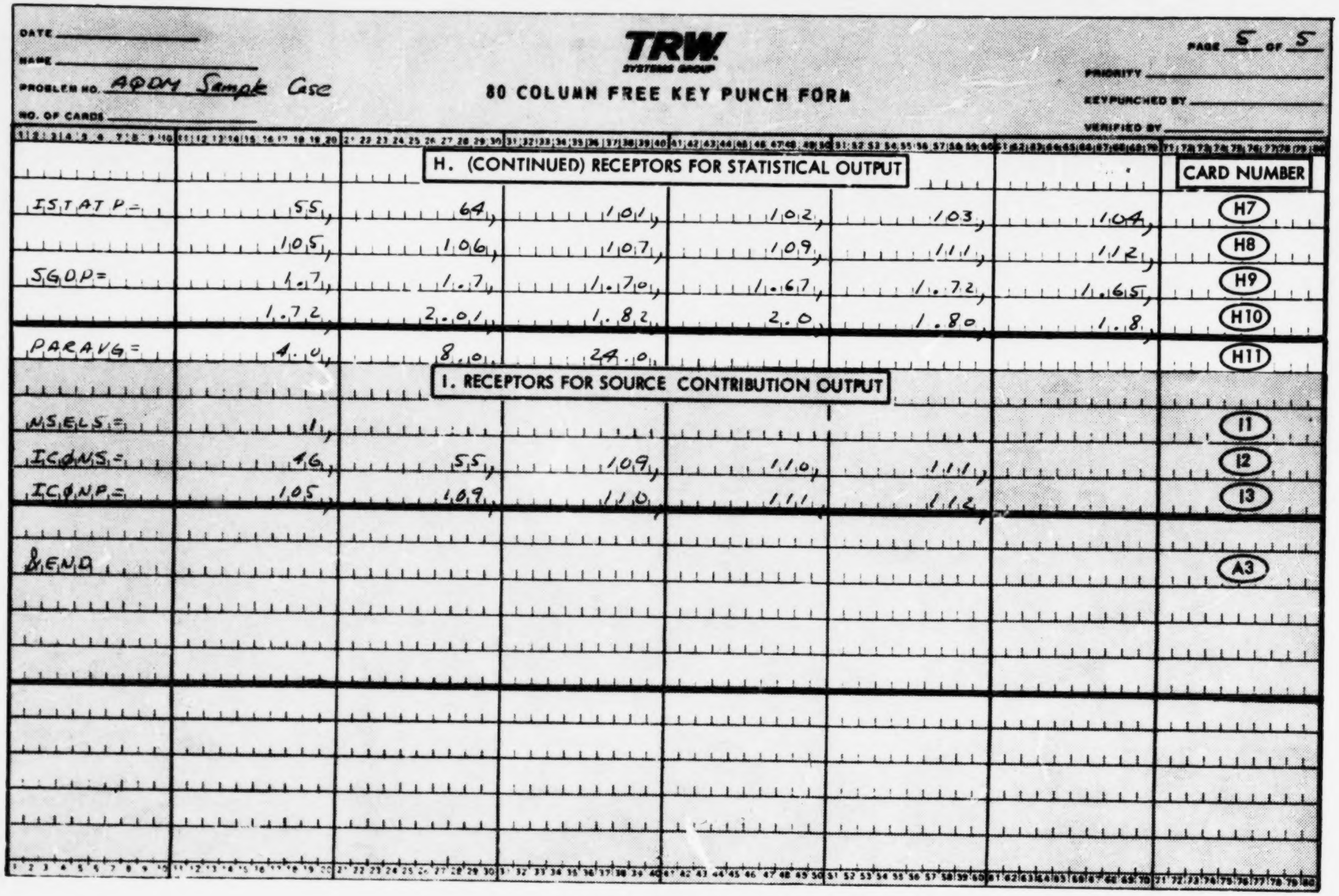
PRIORITY
KEYPUNCHED BY
VERIFIED BY

			F. GRID RECEPTOR DATA				CARD NUMBER
RBASE=	550.0,	4372.5,					F1
INCRY=	1.0,						F2
INCRX=	1.0,						F3
DELTA=	5.,						F4
			G. NON-GRID RECEPTOR LOCATIONS				
IADD=	12,						G1
XRECEP=	562.0,	4395.7,	566.1,	4400.0,	570.0,	4393.2,	G2
	573.9,	4388.9,	572.5,	4396.7,	572.4,	4402.2,	G3
	579.0,	4394.0,	577.5,	4397.5,	576.0,	4403.0,	
	582.5,	4392.5,	583.0,	4399.2,	582.5,	4402.5,	
			H. RECEPTORS FOR STATISTICAL OUTPUT				
NSEL12=	1,						H1
ISTATS=	34,	55,	64,	101,	102,	103,	H2
	104,	106,	107,	109,	111,	112,	H3
SGDS=	1.8,	1.9,	1.8,	1.81,	1.79,	1.83,	H4
	1.77,	2.35,	1.96,	2.3,	1.92,	1.9,	H5
SØ2AVG=	1.0,	8.0,	24.0,				H6

FIELD

a VARIABLE NAME	b	c	d	e	f	g	h
			CARD H1				
NSELI2=	1 - IF RECEPTORS ARE SELECTED IF OMITTED, NO RECEPTORS ARE SELECTED FOR STATISTICAL OUTPUT	NOT USED					
			CARD H2				
ISTATS=	NUMBER OF THE FIRST RECEPTOR SELECTED FOR SO_2 STATISTICAL OUTPUT (NO DECIMAL; RIGHT-JUSTIFIED)	NUMBER OF SECOND RECEPTOR; SO_2 STATISTICAL OUTPUT	NUMBER OF THIRD RECEPTOR; SO_2 STATISTICAL OUTPUT	NUMBER OF FOURTH RECEPTOR; SO_2 STATISTICAL OUTPUT	NUMBER OF FIFTH RECEPTOR; SO_2 STATISTICAL OUTPUT	NUMBER OF SIXTH RECEPTOR; SO_2 STATISTICAL OUTPUT	NOT USED
			CARD H3				
NOT USED	NUMBER OF SEVENTH RECEPTOR SELECTED FOR SO_2 STATISTICAL OUTPUT (NO DECIMAL; RIGHT-JUSTIFIED)	NUMBER OF EIGHTH RECEPTOR; SO_2 STATISTICAL OUTPUT	NUMBER OF NINTH RECEPTOR; SO_2 STATISTICAL OUTPUT	NUMBER OF TENTH RECEPTOR; SO_2 STATISTICAL OUTPUT	NUMBER OF ELEVENTH RECEPTOR; SO_2 STATISTICAL OUTPUT	NUMBER OF TWELFTH RECEPTOR; SO_2 STATISTICAL OUTPUT	NOT USED
			CARD H4				
SGDS=	**SO_2 STANDARD GEOMETRIC DEVIATION FOR FIRST RECEPTOR SELECTED FOR SO_2 STATISTICAL OUTPUT**	SO_2 STANDARD GEOMETRIC DEVIATION FOR SECOND RECEPTOR	SO_2 STANDARD GEOMETRIC DEVIATION FOR THIRD RECEPTOR	SO_2 STANDARD GEOMETRIC DEVIATION FOR FOURTH RECEPTOR	SO_2 STANDARD GEOMETRIC DEVIATION FOR FIFTH RECEPTOR	SO_2 STANDARD GEOMETRIC DEVIATION FOR SIXTH RECEPTOR	NOT USED
			CARD H5				
NOT USED	SO_2 STANDARD GEOMETRIC DEVIATION FOR SEVENTH RECEPTOR	SO_2 STANDARD GEOMETRIC DEVIATION FOR EIGHTH RECEPTOR	SO_2 STANDARD GEOMETRIC DEVIATION FOR NINTH RECEPTOR	SO_2 STANDARD GEOMETRIC DEVIATION FOR TENTH RECEPTOR	SO_2 STANDARD GEOMETRIC DEVIATION FOR ELEVENTH RECEPTOR	SO_2 STANDARD GEOMETRIC DEVIATION FOR TWELFTH RECEPTOR	NOT USED
			CARD H6				
S02AVG=	**FIRST DESIRED AVERAGING TIME FOR SO_2 STATISTICAL OUTPUT, HOURS**	**SECOND SO_2 AVERAGING TIME**	**THIRD SO_2 AVERAGING TIME**	NOT USED			

Figure 4-H. Receptors Selected for Statistical Output



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DATE
NAME
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NO. OF CARDS
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PRIORITY
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VERIFIED BY

			H. (CONTINUED) RECEPTORS FOR STATISTICAL OUTPUT				CARD NUMBER
ISTATP=	55,	64,	101,	102,	103,	104,	(H7)
	105,	106,	107,	109,	111,	112,	(H8)
SGDP=	1.7,	1.7,	1.70,	1.67,	1.72,	1.65,	(H9)
	1.72,	2.01,	1.82,	2.0,	1.80,	1.8,	(H10)
PARAVG=	4.0,	8.0,	24.0,				(H11)
			I. RECEPTORS FOR SOURCE CONTRIBUTION OUTPUT				
NSELS=	1,						(I1)
ICONS=	46,	55,	109,	110,	111,		(I2)
ICONP=	105,	109,	110,	111,	112,		(I3)
&END							(A3)

FIELD

a VARIABLE NAME	b	c	d	e	f	g	h
			CARD	H7			
ISTATP=	NUMBER OF THE FIRST RECEPTOR SELECTED FOR PARTICULATE STATISTICAL OUTPUT (NO DECIMAL; RIGHT-JUSTIFIED)	NUMBER OF SECOND RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NUMBER OF THIRD RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NUMBER OF FOURTH RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NUMBER OF FIFTH RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NUMBER OF SIXTH RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NOT USED
			CARD	H8			
NOT USED	NUMBER OF THE SEVENTH RECEPTOR SELECTED FOR PARTICULATE STATISTICAL OUTPUT (NO DECIMAL; RIGHT-JUSTIFIED)	NUMBER OF EIGHTH RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NUMBER OF NINTH RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NUMBER OF TENTH RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NUMBER OF ELEVENTH RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NUMBER OF TWELFTH RECEPTOR; PARTICULATE STATISTICAL OUTPUT	NOT USED
			CARD	H9			
SGDP=	**PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE FIRST RECEPTOR SELECTED FOR PARTICULATE STATISTICAL OUTPUT**	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE SECOND RECEPTOR	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE THIRD RECEPTOR	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE FOURTH RECEPTOR	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE FIFTH RECEPTOR	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE SIXTH RECEPTOR	NOT USED
			CARD	H10			
NOT USED	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE SEVENTH RECEPTOR	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE EIGHTH RECEPTOR	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE NINTH RECEPTOR	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE TENTH RECEPTOR	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE ELEVENTH RECEPTOR	PARTICULATE STANDARD GEOMETRIC DEVIATION FOR THE TWELFTH RECEPTOR	NOT USED
			CARD	H11			
PARAVG=	**FIRST DESIRED AVERAGING TIME FOR PARTICULATE STATISTICAL OUTPUT, HOURS**	**SECOND PARTICULATE AVERAGING TIME**	**THIRD PARTICULATE AVERAGING TIME**	**NOT USED**			

Figure 4-H (Continued). Receptors Selected for Statistical Output

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DATE
NAME
PROBLEM NO. AQDM Sample Case
NO. OF CARDS

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PRIORITY
KEYPUNCHED BY
VERIFIED BY

H. (CONTINUED) RECEPTORS FOR STATISTICAL OUTPUT

							CARD NUMBER
ISTATP=	55,	64,	101,	102,	103,	104,	H7
	105,	106,	107,	109,	111,	112,	H8
SGOP=	1.7,	1.7,	1.70,	1.67,	1.72,	1.65,	H9
	1.72,	2.01,	1.82,	2.0,	1.80,	1.8,	H10
PARAVG=	4.0,	8.0,	24.0,				H11

I. RECEPTORS FOR SOURCE CONTRIBUTION OUTPUT

							CARD NUMBER
NSELS=	1,						I1
ICØNS=	46,	55,	109,	110,	111,		I2
ICØNP=	105,	109,	110,	111,	112,		I3
&END							A3

FIELD

a VARIABLE NAME	b	c	d	e	f	g	h
NSEL5=	SET TO 1 (NO DECIMAL; RIGHT JUSTIFIED) IF RECEPTORS ARE TO BE SELECTED. IF THIS CARD IS OMITTED THE PROGRAM WILL SELECT THE 5 MAXIMUM RECEPTORS	NOT USED	CARD ⑪				
ICØNS=	NUMBER OF FIRST SO_2 RECEPTOR SELECTED FOR THE SOURCE CONTRIBUTION OUTPUT	NUMBER OF SECOND SO_2 RECEPTOR, SOURCE CONTRIBUTION OUTPUT	CARD ⑫ NUMBER OF THIRD SO_2 RECEPTOR, SOURCE CONTRIBUTION OUTPUT	NUMBER OF FOURTH SO_2 RECEPTOR, SOURCE CONTRIBUTION OUTPUT	NUMBER OF FIFTH SO_2 RECEPTOR, SOURCE CONTRIBUTION OUTPUT	NOT USED	
ICØNP=	NUMBER OF FIRST PARTICULATES RECEPTOR SELECTED FOR THE SOURCE CONTRIBUTION OUTPUT	NUMBER OF SECOND PARTICULATES RECEPTOR, SOURCE CONTRIBUTION OUTPUT	CARD ⑬ NUMBER OF THIRD PARTICULATES RECEPTOR, SOURCE CONTRIBUTION OUTPUT	NUMBER OF FOURTH PARTICULATES RECEPTOR, SOURCE CONTRIBUTION OUTPUT	NUMBER OF FIFTH PARTICULATES RECEPTOR, SOURCE CONTRIBUTION OUTPUT	NOT USED	

Figure 4-I. Receptors Selected for Source Contribution Output

GLOSSARY OF AQDM INPUT VARIABLES

Name		Description	Page
BACKGR	-	array including background concentrations for SO_2 and particulates	4-19
DELTA	-	spacing between rows and columns of receptors	4-23
DPTHMX	-	average afternoon mixing depth	4-15
&END	-	control card (last card in deck) indicating that all input data cards have been read	4-11
IADD	-	number of non-grid receptors	4-25
IC0NP	-	receptor numbers for those particulate receptors selected for source contribution output	4-31
IC0NS	-	receptor numbers for those SO_2 receptors selected for source contribution output	4-31
IFLAG	-	flag to indicate which calibration option is to be used	4-21
INCRY	-	number of rows of receptor grids	4-23
INCRX	-	number of columns of receptor grids	4-23
&INDATA	-	control card (first card in deck) indicating that data on all cards following this card is to be read into the AQDM as input	4-11
IPUNCH	-	flag to indicate whether or not cards for map plotting are to be punched	4-21
ISTATP	-	receptor numbers for those particulate receptors selected for statistical output	4-29
ISTATS	-	receptor numbers for those SO_2 receptors selected for statistical output	4-27
NPART	-	number of particulate sampling stations to be used in calibration	4-19
NP0LUT	-	flag to indicate which pollutants are to be considered	4-21
NSEL5	-	flag to indicate receptor selection for source contribution output	4-31
NSEL12	-	flag to indicate whether or not statistical output is to be provided	4-27
NS02	-	number of SO_2 measuring stations to be used in calibration	4-17

GLOSSARY (Continued)

Name		Description	Page
NSØRCE	-	number of sources input	4-13
PA	-	ambient pressure	4-15
PARAVG	-	averaging times for particulate statistical output	4-29
PARCAL	-	regression line constants for particulates	4-21
PARØB	-	array including particulate sampling station locations and measurements	4-19
PLUME	-	array including stack exit velocity, stack diameter, and stack exhaust temperature for each source	4-13
RBASE	-	coordinates of grid receptor origin	4-23
REGIØN	-	any desired combination of letters and numbers which will serve as an identifier on the printed output	4-11
SGDP	-	particulate standard geometric deviations for statistical output receptors	4-29
SGDS	-	SO_2 standard geometric deviations for statistical output receptors	4-27
SØ2AVG	-	averaging times for SO_2 statistical output	4-27
SØ2CAL	-	regression line constants for SO_2	4-21
SØ2ØB	-	array including SO_2 sampling station locations and measurements	4-17
SØRCE	-	array including source location, area, emission rate, and physical stack height for each source	4-13
TA	-	ambient temperature	4-15
WNDFRQ	-	array of stability wind rose data	4-15
XRECEP	-	locations of non-grid receptors	4-25

5.0 DESCRIPTION OF OUTPUT

5.0 DESCRIPTION OF OUTPUT

The complete program output from an actual computer run for the Test City sample case is presented in Appendix C. The first line on each page of output lists the run identifier, and the second line gives the name of the output table on that page. For example, on page C-17, "TEST CITY" identifies the run, and "STATISTICAL DATA FOR SELECTED RECEPTORS" identifies the table printed on that page. The run identifier can be any combination of letters and numbers selected by the user and input using the REGION card (page 4-11). The content of each of the output tables is described below.

Some of the data presented in these tables are the result of computations within AQDM, while some are simply repeats of the data input by the user. The tables of user-supplied data are intermingled with those which result from program calculations to produce a more convenient means of analyzing the results of the run. This also allows reconstruction of the run, i.e., the user will have a record of input data used. Actual tables will generally be longer than those presented in Appendix C, since the hypothetical Test City has only 21 point and area sources.

5.1 SOURCE DATA

The emission inventory which was prepared as input in Chapter 3 is itemized in a source data output table (page C-1). Each point and area source in the region is listed on a separate line in this table. For each source, the location, area, emission rates, and conditions at the stack exit are given. For point sources (indicated by zero area), the physical stack height (HT), stack exit diameter (DIAM), and effluent velocity (VEL) and temperature (TEMP) are listed as they were input. As was indicated in Chapter 4, these specific values were used by the AQDM program to calculate the effective stack height at which the plume became horizontal.

The calculated value of effective stack height is not shown in the table. However, where values for stack diameter and effluent velocity and temperature were not input, the input height value as listed serves as the estimated effective stack height. The emission rate represents a daily average value for the annual period under consideration.

5.2 RECEPTOR DATA

This table (page C-2) presents the identification numbers and locations of the non-grid receptors described in the numbering scheme, Step G (3), page 3-9, and prepared input (Figure 4-G).

These non-grid receptors are numbered sequentially in the order in which they are input, starting from the last grid receptor number, and are listed in numerical order. The numbers and locations of these non-grid receptors were specified as input and are relisted in this output table merely as a convenient cross-index. A given number consistently identifies a specific site throughout the program. The same number of non-grid receptors will appear in this table as were input, up to a maximum of 12.

5.3 METEOROLOGICAL INPUT DATA FOR THE ANNUAL SEASON

Wind roses for five stability classes which were input in Chapter 3 are listed as outputs in these tables (pages C-3 through C-7), one wind rose per page. Stability classes 1 through 5 correspond to very unstable, moderately unstable, slightly unstable, neutral, and stable conditions, respectively. For each stability class (i.e., on any given page), the frequency of occurrence of each of the 6 wind speed classes (0-3, 4-6, 7-10, 11-16, 17-21 and over 21 knots) is listed for each of the 16 wind directions. A total of 480 wind frequency values are thus listed. The sum of these frequency values equals unity.

5.4 RECEPTOR INFORMATION FOR STATISTICAL OUTPUT

This table (page C-8) lists the receptors which were input for calculated statistical output data and indicates the standard geometric deviations of pollution concentration specified at each of these receptors for a 24-hour averaging time. The standard geometric deviations are the base values from which the statistical output values (pages C-15 through C-20) are calculated.

Chapter 3 specified that the receptors were to be selected from the total set (grid plus non-grid) of input receptors and that standard geometric deviation values for the 24-hour averaging time were to be derived from measured air quality data where it existed at the receptor location. Where measured values did not exist at the location, standard geometric deviations at the location were estimated by interpolation or extrapolation from near-by measuring stations. The user should remember that statistical calculations based on the estimated values will be less reliable than those based on measured air quality data.

5.5 REGRESSION PARAMETERS FOR CALCULATED (X-AXIS) VS. OBSERVED (Y-AXIS) CONCENTRATIONS

This table (page C-9) summarizes the results of the calibration of the model for the specific region. The table includes one line for each pollutant considered. Two constants for each pollutant (Y-intercept and slope) are shown. These constants define the best (least-squares fit) linear equation describing the relationship between calculated and observed concentrations. In addition to the constants, a computed regression coefficient and a 5%-confidence-level regression coefficient are shown. When the value of the computed coefficient is greater than that of the 5% confidence level, calibration is considered to be satisfactory. Each equation is then used by the computer program to adjust the air quality values as dictated by the calibration.

When the computed value of the regression coefficient is less than that corresponding to the 5% confidence level, the following note will be printed in the table: "POOR CORRELATION COEFFICIENTS NOT USED." When this occurs, the air quality values at receptors will be printed without the use of these regression constants. It should also be noted that in this case the constants should not be input using the S02CAL= and PARCAL= cards (Figure 4-E). Instead, the reason for the poor correlation should be determined and the necessary corrections made.

5.6 CORRELATION DATA

The air quality data used to calibrate the model is listed in these tables (pages C-10 and C-11). A separate table is printed for each pollutant, giving the station number, location, and annual arithmetic average concentration at ground level. The last two columns present, respectively, the observed (measured) concentration and estimated concentration as computed by the diffusion model at each selected monitoring station. Background concentrations which were input are included in the column containing the calculated values. The data in these two columns is used in the computer program to calculate the regression parameters used for the calibrations previously described in 5.5 Only the last column in the table contains values computed by the program. Data in the other columns were input and displayed here to allow comparison of observed and computed concentrations at each location, as in the development of the calibration curves.

5.7 RECEPTOR CONCENTRATION DATA

The primary output of the diffusion model is presented in this table (pages C-12 through C-14). Each grid and non-grid receptor is listed on a separate line, by receptor number, together with the location and ground-level concentration for each pollutant as computed by the diffusion model. The term "expected" in the heading over the last two columns is not used in the strict statistical sense, but merely indicates that the values are predictions or estimates made by the diffusion model.

If calibration of the model was requested and was successful (i.e., the calculated regression coefficient exceeded the 5% confidence level), the values printed in this table will have been adjusted using the regression-line parameters.

5.8 STATISTICAL DATA FOR SELECTED RECEPTORS

A table of statistical data is printed for each pollutant and averaging-time combination specified (pages C-15 through C-20). In each table, statistical data for the specified receptors (as tabulated in "RECEPTOR INFORMATION FOR STATISTICAL OUTPUT," page C-8) comprises the expected arithmetic mean (used here in the sense of predicted or estimated arithmetic mean) from the diffusion model; the standard geometric deviation, which is the input value converted to the desired averaging time; and the expected geometric mean and expected maximum concentration values, which are calculated from the expected arithmetic mean and standard geometric deviation values. Again, if calibration of the model was requested and was successful, the arithmetic mean values used in this calculation will have been adjusted using the regression line parameters.

5.9 SOURCE CONTRIBUTIONS TO FIVE SELECTED (MAXIMUM) RECEPTORS

The contributions of each point and area source in the region to the five selected or five maximum receptors (as indicated in the heading) are presented in this table (pages C-21 through C-24). The source numbers correspond to those used in the SOURCE DATA table (page C-1).

The contribution of a given source to each receptor is indicated both as a percentage of the total concentration at that receptor and as an absolute value (micrograms/cubic meter). The contribution of the background concentration, which is constant throughout the region, is shown in the second line from the bottom (pages C-22 and C-24). The last line contains the total contribution from all sources for each receptor. Since all source contributions and background values are summed, the percentage figure will total 100% and the absolute value will equal the total concentration at each receptor (i.e., the last figure in each receptor column will be the same as that in the CONCENTRATION DATA table, which begins on page C-12). One table will be presented for each pollutant, and the length of the table will depend on the number of sources in the region.

5.10 CALCOMP PLOTS

The data printed in the RECEPTOR CONCENTRATION DATA table (pages C-25 and C-26) is also punched on cards for input to a CALCOMP [1967] plotter. Any desired contour interval of concentration may be selected to display the regional picture of air quality. AQDM provides only the punched cards; a separate computer program [CALCOMP, 1967] is required to generate the isopleth maps. The CALCOMP system has had wide distribution to computer centers throughout the country, and the user should be able to locate at least one center in his area equipped to prepare the required CALCOMP output.

5.11 SYMAP PLOTS

The same card deck which could be used to generate CALCOMP plots can also be used to make SYMAP [1968] plots (pages C-27 and C-28). This technique requires only the SYMAP program and a line printer, and gives shading in addition to the isopleth contours. If the SYMAP program is not available at a local computer center, the user may obtain the program from the Harvard University Laboratory for Computer Graphics and Spatial Analysis, Cambridge, Massachusetts.

APPENDIX A
MATHEMATICAL DESCRIPTION OF DIFFUSION AND STATISTICAL MODELS

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APPENDIX A

A.1 DIFFUSION

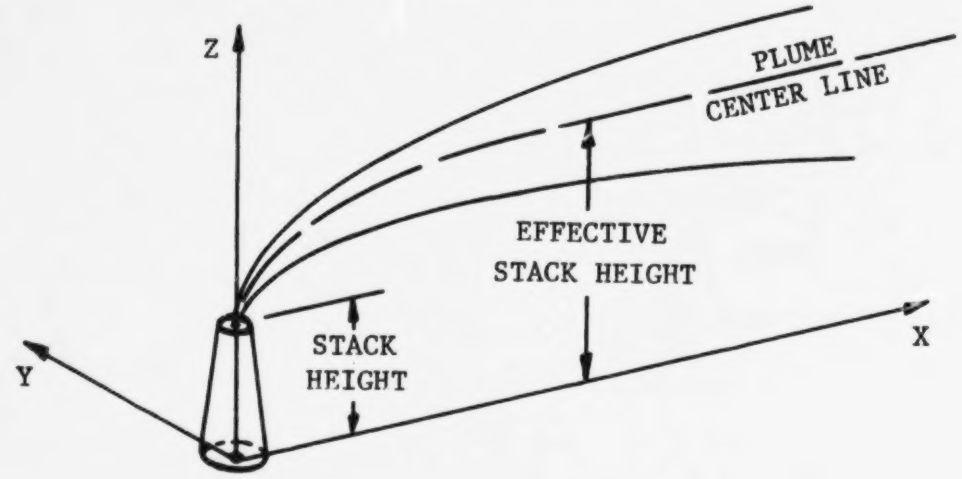
The Air Quality Display Model (AQDM) is based upon a diffusion model developed by Martin and Tikvart [1968]. The basic output of the AQDM is in the form of calculated average annual pollutant concentrations at ground level. Concentrations for shorter periods are estimated by means of a statistical technique developed by Larsen [1969] and discussed in Section A.2.

Sutton [1932] and Bosanquet [1936] provided the first point source diffusion equations. Sutton's equations were widely used to estimate downwind concentrations from single sources until the early 1960's. Because the mixing and dilution of airborne trace substances are accomplished primarily by atmospheric turbulence, no exact or general solution of an atmospheric diffusion equation is possible. Sutton and Bosanquet expressed downwind concentrations as solutions to appropriate diffusion equations, but the coefficients of diffusion employed ("eddy mixing coefficients") were derived from vertical wind profiles obtained during field experiments.

Later, Pasquill [1961] presented a method for estimating concentrations when wind profiles are not available. This method expresses the vertical and horizontal angular spread of a diffusion plume as functions of downwind distance, mean local wind speed, and atmospheric stability. Gifford [1961] converted Pasquill's formulation into expressions based upon the lateral and vertical standard deviations (σ_y and σ_z) of plume concentration distributions. The Pasquill-Gifford plume formulation, now widely used, is described in detail in a recent summary by Turner [1961].

The Martin-Tikvart model calculates concentrations downwind from a set of point and area sources on the basis of the Pasquill-Gifford point source formulation. A description of this process follows;

The stack in the illustration on page A-2 represents a typical elevated point source. The coordinate system for this source has its origin at ground level at the base of the stack (i.e., directly below the effective point of emission). The X-axis extends horizontally in the mean wind direction. The Y-axis is horizontal in the cross-wind (and cross-plume) direction. The Z-axis is vertical.



The "effective stack height" (or effective height of emission release) is the height at which the plume center line becomes horizontal. The effective stack height is the sum of the physical stack height and an incremental factor related to the buoyancy and vertical momentum of the effluent.

The concentration, χ, at a position (x,y,z) for substances emitted at (0,0,h) is given by

$$\chi\,(x,y,z;\,h) = \frac{10^6 Q}{2\pi\sigma_y\sigma_z u}\,\exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right]\left\{\exp\left[-\frac{1}{2}\left(\frac{z-h}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+h}{\sigma_z}\right)^2\right]\right\} \qquad (A.1)$$

where:

$\chi\,(x,y,z;\,h)$ = pollutant concentration at point x,y,z for an effective stack height h, micrograms/meter^3

Q = emission rate, grams/sec.

u = mean wind speed, meters/sec.

σ_y, σ_z = standard deviation of the plume concentration distribution in the cross-plume and vertical directions, meters. (σ_y and σ_z are given as functions of downwind distance and atmospheric stability.)

Equation (A.1) is based upon several assumptions, including:

(a) Total reflection of the plume takes place at the earth's surface.

(b) The plume description represents conditions averaged over a time period of several minutes. The "instantaneous" behavior of the plume, particularly during unstable atmospheric conditions, is more complex.

(c) The effluent has neutral buoyancy in the atmosphere; no fall-out or buoyancy rise is modeled by Equation (A.1). In the case of actual effluents, all contaminant gases and most particles with equivalent diameters less than 20 microns satisfy this assumption. For larger particulate material, the simple plume description must be modified to include a fall-out effect.

(d) The time-averaged plume exhibits a Gaussian distribution of concentrations in the cross-plume and vertical dimensions. The measures of the spread in both directions (the standard deviations) are considered to be a function of downwind distance and atmospheric stability only.

(e) The plume is a steady-state phenomenon resulting from a constant, continuous emission source, and none of the effluent "disappears" (by chemical change or by absorption on the ground surface, for example). Thus, an area integration of the plume concentration in any plane perpendicular to the center line is constant, regardless of the downwind distance.

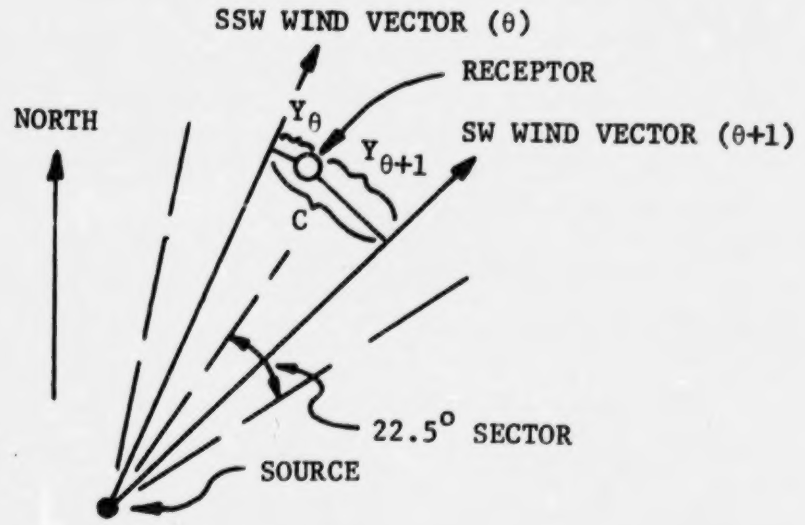
Ground-level concentration estimates are obtained by setting z = 0 in Equation (A.1), resulting in

$$\chi\ (x,y,z;\ h) = \frac{10^6 Q}{\sigma_y \pi \sigma_z u} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right] \exp\left[-\frac{1}{2}\left(\frac{h}{\sigma_z}\right)^2\right] \qquad (A.2)$$

For a source which emits at a constant rate from hour to hour and day to day, Equation (A.2) can be modified to yield estimates of annual average concentrations if applicable stability wind rose data are available. A wind rose tabulates the frequency of occurrence for each wind direction and wind speed class during a standard climatological period.

A stability wind rose contains the same information, but it is further divided according to atmospheric stability classes.

Although the change in wind direction is a continuous function over the long-term period, for computation purposes discrete wind directions are specified with respect to a 16-point compass, corresponding to 22.5-degree circular sectors. For annual periods it is often assumed that all wind directions within a given 22.5-degree sector occur with equal frequency. Thus the effluent could be assumed to be uniformly distributed in the horizontal within the sector. However, this assumption would result in discontinuities in calculated concentrations at sector boundaries. A more reasonable distribution is obtained by using a linear interpolation between sector center lines. Thus, the concentration at a given receptor location is composed of proportional contributions from both the sector containing the receptor and from the nearest adjacent sector. The linear interpolation term is given by (c-y)/c, where y is the crosswind distance between the receptor and the sector center line, and c is the sector width at the receptor location. This concept is illustrated in the following sketch. Note that a SSW wind affects the receptor to the NNE of the source.



Use of the linear crosswind distribution changes the form of Equation (A.2) to the univariate Gaussian distribution:

$$\chi = \frac{2 \times 10^6 Q(c-y) / c}{u\sigma_z \sqrt{2\pi} \ (2\pi x/16)} \exp\left[-\frac{1}{2}\left(\frac{h}{\sigma_z}\right)^2\right] \quad \text{(A.3)}$$

Vertical plume rise is inhibited by the existence of a stable atmospheric layer having a base lower than the effective stack height (the layer elevation will generally range between 100 and 3,000 feet). The rate of vertical mixing is greatly reduced in such a layer, and the base of the layer can thus be considered as an effective "lid" on vertical transport of pollutants.

When an elevated stable layer occurs locally, the estimated pollutant concentrations can be calculated with the assumption that all the effluent remains within a mixing layer depth L, defined as the vertical distance from the ground to the base of the stable layer. For the model calculations, σ_z is considered to increase in the downwind direction until it reaches a distance X_L at which $\sigma_z = 0.47L$. At this distance, pollutant concentration at the base of the stable layer will be one-tenth that at the plume center line. Up to this distance, the Gaussian vertical distribution is assumed, and Equation (A.3) is appropriate. At distance X_L the trapping effect of the elevated stable layer begins to be effective, and uniform mixing below the base of the stable layer is assumed to occur at downwind distance $2X_L$. For distances $X \geq 2X_L$, the average concentration is calculated with the assumption of full mixing in the mixing layer:

$$\chi = \frac{10^6 Q(c-y) / c}{Lu(2\pi x/16)} \qquad \text{(A.4)}$$

For distances between X_L and $2X_L$, χ is determined by a linear interpolation between Equation (A.3), evaluated at X_L, and Equation (A.4), evaluated at $2X_L$.

For a specific source-receptor configuration, an estimate of χ is obtained by choosing a representative wind speed for each wind speed class and solving the appropriate equation for all wind speed and stability classes appropriate for the time period in the geographical area of interest. The average concentration, $\overline{\chi}$, is obtained by summing all concentrations and weighting each one according to its frequency for the particular wind direction, wind speed class, and stability class. The average concentration is:

$$\bar{\chi} = \sum_{\Theta} \sum_{N} \sum_{S} F(\Theta,N,S)\ \chi\ (\Theta,N,S) \qquad (A.5)$$

where:

$F(\Theta,N,S)$ = normalized frequency during the period of interest for wind direction interval Θ, wind speed class N, and stability class S.

$\bar{\chi}(\Theta,N,S)$ = average ground-level concentration calculated from (A.3) or (A.4) as appropriate.

The total concentration at a specific receptor is obtained by summing the results of Equation (A.5) over all sources. For each of the 16 wind direction intervals, wind speed is defined in 6 categories and stability class in 5 categories. Thus a three-dimensional array of 480 categories is established. (However, only a few wind directions result in non-zero contributions for specific source-receptor pairs. Thus the computation time is reduced significantly.) Vertical variations in wind speed and wind direction are not accounted for in the present model.

The representative speeds associated with the six climatological wind speed categories (0-3, 4-6, 7-10, 11-16, 17-21 and >21 knots), are given by the five mid-interval values of 0.67, 2.46, 4.47, 6.93 and 9.61 meters per second, and by 12.52 meters per second (= 25.5 knots) for the >21 knots category.

The five stability categories (S = 1, 2, 3, 4 and 5, in order of increasing atmospheric stability) are defined on the basis of the criteria stated by Turner [1964]. Stability in the lowest part of the atmosphere is determined primarily by the radiative flux divergence and local wind speed. Turner's classification is based upon ground-level meteorological observations only (surface wind speed, cloud cover, ceiling), supplemented by solar elevation data (latitude, time of day, and time of year); thus the stability estimates can be obtained for any Weather Bureau station at which continuous observations have been made. No vertical sounding data (available from principal stations only) is needed.

The values of σ_z (X,S) used in the program are those of Pasquill [1961] and Gifford [1961]. For computation these are represented in the form $\sigma_z = aX^b + c$, where a, b and c are constants for each stability class, as shown in the following table. No a, b and c values are stated for S = 5 in the table. Class 5 is associated with nighttime, surface inversion conditions, and the σ_z values for this case are the smallest normally used. However, because of the thermal and mechanical influences of urban areas, the lowest part of the typical urban atmosphere is less stable than its rural counterpart. Since the diffusion model is intended for use in urban regions, the σ_z values for $S = 4$ are always used when the meteorological criteria indicate $S = 5$.

The minimum value of X used in calculating σ_z is 100 meters. If $X < 100$ meters, X is set equal to 100 meters prior to the σ_z calculation.

Stability Class (S)		a	b	c
1 ∿ Very Unstable		.001	1.890	9.6
2 ∿ Moderately Unstable		.048	1.110	2.0
3 ∿ Slightly Unstable		.119	.915	0.0
4 ∿ Neutral	$X > 1000$ meters	2.610	.450	-25.5
	$X \leq 1000$ meters	.187	.755	- 1.4

The mixing layer depth, L, varies greatly from season to season, day to day, and diurnally. Since it is impractical to account for all these variations, a procedure reflecting only major changes is used in the model. The procedure determines an effective mixing depth by modifying the average afternoon mixing depth values, as tabulated by Holzworth [1964], according to the stability class being considered. Stability classes $S = 1$, 2 and 3 are afternoon conditions, with $S = 1$ corresponding to very unstable conditions. When $S = 1$, the value of L is assumed to be 50% greater than the climatological value tabulated by Holzworth; when $S = 2$ or 3, the climatological value is adopted. According to Turner's criteria, $S = 5$ can occur only when nighttime ground-based inversion conditions exist. Since a shallow layer of neutral or weak lapse conditions has been found to occur over urban areas (even with strong nocturnal surface inversions in the surrounding rural areas), a mixing depth of $L = 100$ meters is adopted for stability class $S = 5$, when this class is indicated by the objective criteria. The 100-meter value is based upon observations of Clarke [1969]. Stability class $S = 4$ is a neutral stability condition which occurs either with high wind speeds during the day or with high negative net radiation during the night. To find the mixing depth for the transition period, average the nighttime and afternoon mixing depth values for 2/5 of the class S = 4 occurrences. The remaining 3/5 of the class S = 4 occurrences utilizes the climatological value.

The effective stack height, appearing in Equation (A.3), is defined as the height of the plume centerline when it becomes horizontal. Thus $h = h^* + \Delta h$, where h^* is the physical stack height and Δh is the plume rise. The effective stack height does not appear in Equation (A.4) because the height of emission is immaterial after vertical mixing is complete.

The plume rise equation used in the program (when actual point sources are being considered) is due to Holland [1953], and is given by

$$\Delta h = \frac{V_s d}{u} \left[1.5 + 2.68 \times 10^{-3} P \left(\frac{T_s - T_a}{T_s} \right) d \right] \qquad (A.6)$$

where:

V_s = stack gas-exit velocity (meters/sec.)

d = stack exit diameter (meters)

u = mean wind speed (meters/sec.)

P = atmospheric pressure (mb)

T_s = stack gas-exit temperature (°K)

T_a = ambient air temperature (°K)

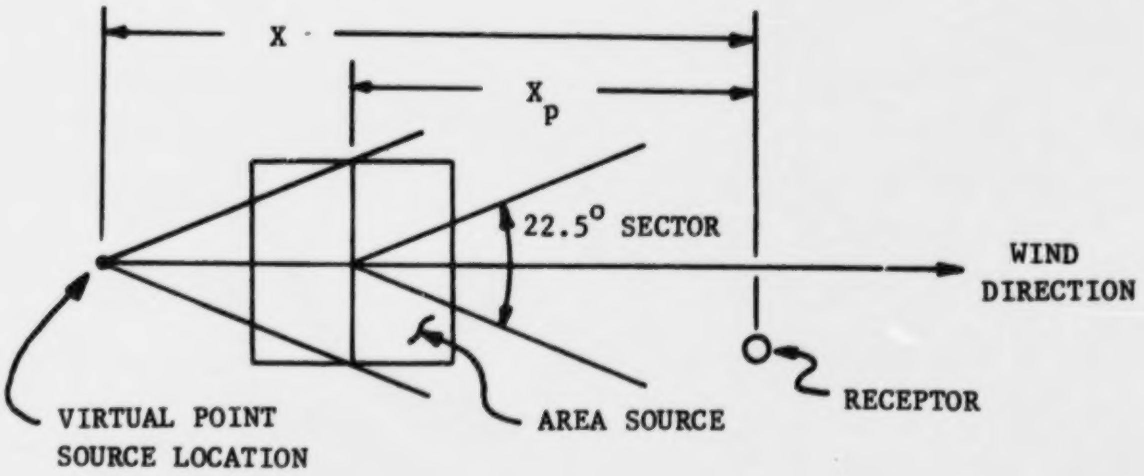
Since this equation is appropriate for the neutral stability condition, it must be modified for application over a range of stability conditions. The following modification is used to allow for a range of from 1.3 Δh for very unstable conditions to Δh for neutral stability.

$$h = h^* + \Delta h(1.4 - 0.1S)$$

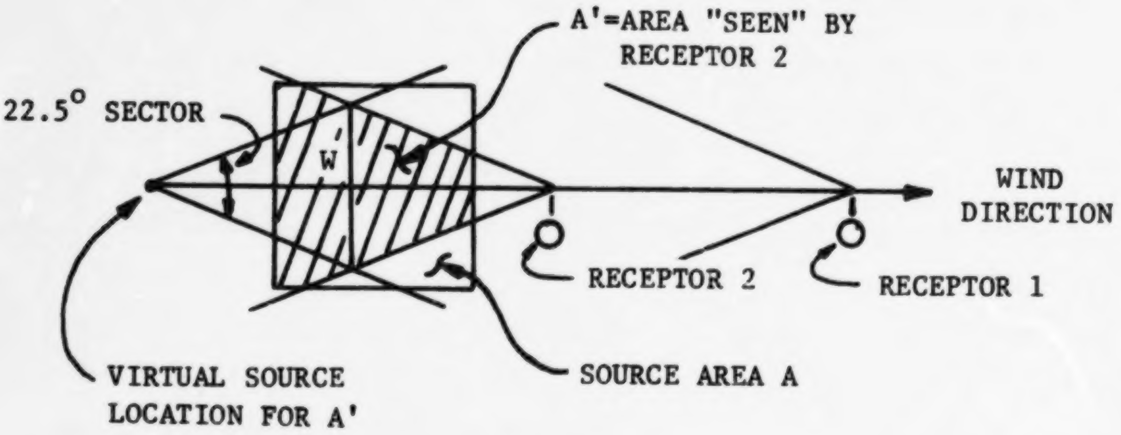
The plume rise equation (A.6) frequently underestimates the effective height of emission; thus its use often provides a slight "safety" factor. For some point sources (e.g., power plants with tall stacks), the effective emission height will be above the mixing depth when the mixing depth is low. Based on the assumption that the plume will not disperse downward through the stable layer, these cases are identified and eliminated from consideration by the program. For area sources an average effective height of emission must be estimated.

The program handles area sources by converting them to equivalent or "virtual" point sources. In the conversion process, both the downwind distance and source strength are dependent on the particular source-receptor configuration.

If the total emission is calculated as though at the center of the source area, concentrations downwind tend to be overcalculated, especially for nearby receptors. Since uniform spread across the sector is assumed, it is logical to proceed a step further and assume a virtual point source at such a distance upwind that the 22.5-degree sector used subtends the area width. This concept is illustrated in the following sketch. Here the program would use X instead of X_p as the source-receptor downwind distance in Equation (A.3) or (A.4). The vertical spread, as measured by σ_z, is still calculated using X_p, the actual downwind distance.



In a similar manner, nearby receptors are affected by emissions from only a portion of the source area and, therefore, would be overcalculated if the total area emission value were used. To correct this, the source emission rate is multiplied by an "area utilization" factor, Q*, which is the ratio of that portion of the source area lying within a 22.5-degree sector upwind of the receptor (A') to the total area (A). For example, in the sketch on the following page, Receptor 1 would use the total area-emission value, Q, while Receptor 2 would use the proportional amount, QQ* = Q(A'/A). Note that in this figure the virtual point source would be defined by the reduced area width, W.



A.2 STATISTICAL SEGMENT

Larsen [1969] has developed a mathematical model for the expression of air pollution concentration as a function of averaging time and frequency, and has demonstrated how the model can be used to relate air quality criteria to air quality standards and emission standards. The model is employed here to convert arithmetic average concentrations to expected maximum concentrations and expected geometric mean concentrations for various averaging times, under the assumption that the standard geometric deviations are known. Output therefore will consist of the following:

(a) Geometric mean concentrations for various averaging times.

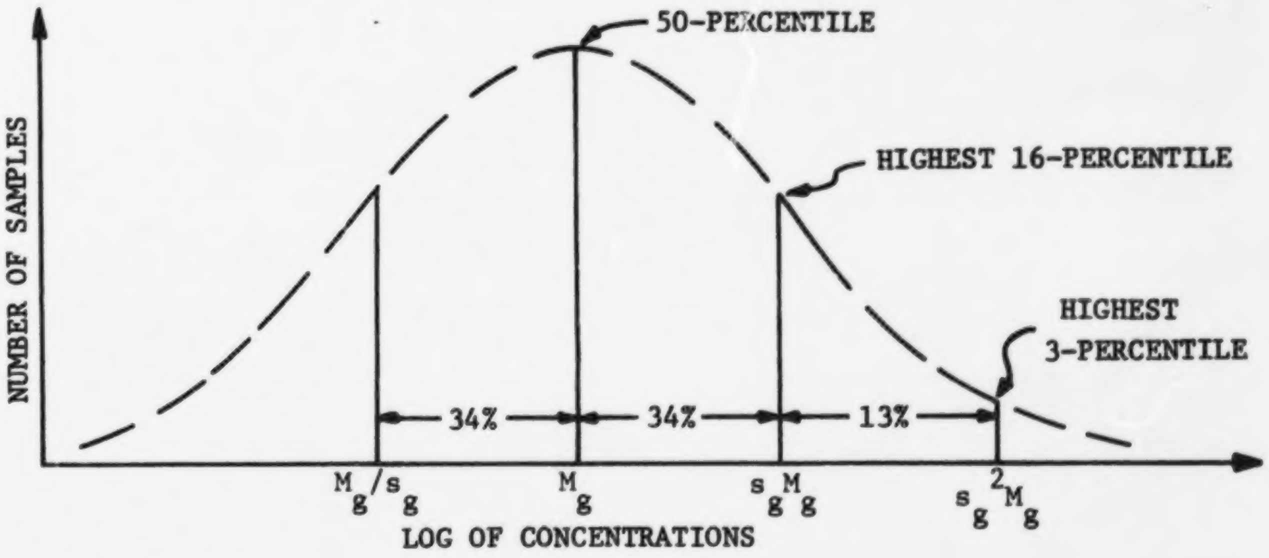
(b) Maximum expected concentrations for various averaging times.

The Larsen model was constructed on the basis of the following characteristics, as observed from analysis of seven pollutants for six cities over a three-year period:

(a) Concentrations are approximately lognormally distributed for all pollutants in all cities for all averaging times.

(b) The median concentration (50 percentile) is proportional to averaging time to an exponent.

If air quality data for the major cities are plotted on log-probability paper (for given averaging times), the resulting curves are nearly straight lines. This suggests that, to a good approximation, the distribution of samples follows a lognormal curve. The sketch below represents such a curve, with the logarithm of concentrations plotted on the horizontal axis and the number of samples obtained for each concentration (for a given averaging time) plotted on the vertical axis. The curve follows the familiar, bell-shaped probability distribution, the only difference being that the logarithm of concentration is plotted rather than the concentration itself. The center of such a curve falls not on the arithmetic-mean but on the geometric-mean (50-percentile) concentration. This is the concentration which divides equally the area under the curve: half of the samples will lie above this value and half will lie below it. As with the normal probability curve, the standard deviation is a measure of the "spread" of the curve. However, for the lognormal distribution, it is called the standard geometric deviation, and is the ratio of the concentration which is exceeded by 16% of the samples to that which is exceeded by 50% of the samples.



Since only two parameters are needed to define the shape of this distribution, it is possible, once these parameters are known, to calculate the concentration for any percentile. In addition, since a specified averaging period corresponds to a fixed number of samples over a year, the highest sample will correspond to a particular percentile. Thus, it is also possible to calculate the expected maximum concentration for the year.

Equation (A.7) is a general relationship for calculating the concentration at any point along the curve as a function of the geometric-mean and standard-geometric deviation.

$$C = M_g (s_g)^z \tag{A.7}$$

where:

C = concentration corresponding to the desired percentile and averaging time,

s_g = standard geometric deviation of samples (at the desired averaging time),

M_g = geometric mean of samples (at the desired averaging time),

z = plotting position which corresponds to the desired percentile.

The parameters M_g and s_g are obtained from the actual distribution of sample data, while z is the number of standard deviations on a normal probability curve that correspond to the desired percentile and may be obtained from statistical tables [c.f., Pearson and Hartley, 1966]. The table below shows the values of z for several selected percentiles. In the program the z values are obtained by an approximation technique which involves solving the normal, cumulative-probability density function:

$$P = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+z} e^{-x^2/2}\,dx$$

Values of z For Various Frequencies

Highest Percentile	z
50.0%	0.00
30.0%	0.52
15.0%	1.04
10.0%	1.28
5.0%	1.64
1.0%	2.33
0.1%	3.09

Since a particular percentile is associated with the maximum concentration in any set of samples for a specified averaging time, a similar table may be prepared in which the values of z correspond to the maximum concentration for selected averaging times. Such values are listed below and, when used in Equation (A.7), they permit calculation of the expected maximum concentration in a distribution of samples (for a single averaging time) where M_g and s_g are known.

Values of z For Calculating
the Maximum Concentration

Averaging Time	z
1 year	0.00
1 month	1.64
24 hours	2.94
8 hours	3.26
4 hours	3.46
2 hours	3.63
1 hour	3.81

The geometric mean for a given set of samples may be calculated from the arithmetic mean and the standard geometric deviation for that same set of samples in a relatively straightforward manner, as shown in Equation (A.8).

$$M_g = \chi/(s_g)^{(1/2 \ln s_g)} \qquad (A.8)$$

where:

χ = arithmetic mean

M_g = geometric mean for a set of samples

s_g = standard geometric deviation for the same set of samples

ln = the natural logarithm to the base e.

If s_g is for the desired averaging time, Equation (A.7) and Equation (A.8) may be used to provide the desired output. If the desired averaging time is different from the one associated with the input s_g, then s_g must be translated to the desired averaging time. It is assumed that the input s_g corresponds to a 24-hour averaging time.

Larsen proposes a method to change averaging times by assuming that the median concentration is proportional to averaging time to an exponent. The standard geometric deviations for different averaging times may be related as shown in Equation (A.9).

$$s_{g_n} = (s_{g_{24}})^k \qquad (A.9)$$

where:

$$k = \sqrt{\frac{\ln 8760/n}{\ln 8760/24}}$$

and

s_{g_n} = standard geometric deviation at averaging period of n hours

$s_{g_{24}}$ = standard geometric deviation of 24-hour samples

The statistical relationships described above, along with the annual arithmetic mean concentration computed by the diffusion model, allow the user to estimate the expected maximum and geometric mean pollutant concentration at various averaging times.

APPENDIX B
REGIONAL AIR POLLUTION CONTROL DIRECTORS, NAPCA

APPENDIX B

REGIONAL AIR POLLUTION CONTROL DIRECTORS, NAPCA

REGION 1 -- Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

John F. Kennedy Federal Building
Boston, Massachusetts 02203
Phone: 617-223-6883 or 223-6339

REGION 2 -- Delaware, New Jersey, New York, Pennsylvania

Federal Office Building
26 Federal Plaza (Foley Square)
New York, New York 10007
Phone: 212-264-2517

REGION 3 -- District of Columbia, Kentucky, Maryland, North Carolina, Virginia, West Virginia, Puerto Rico, Virgin Islands

220 Seventh Street, N.E.
Charlottesville, Virginia 22901
Phone: 703-296-1387

REGION 4 -- Alabama, Florida, Georgia, Mississippi, South Carolina, Tennessee

Room 404
50 Seventh Street, N.E.
Atlanta, Georgia 30323
Phone: 404-526-5787 or 526-5672

REGION 5 -- Illinois, Indiana, Michigan, Ohio, Wisconsin

New Post Office Building, Room 712
433 West Van Buren Street
Chicago, Illinois 60607
Phone: 312-353-5243 or 353-4589

REGION 6 -- Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota

601 East 12th Street
Kansas City, Missouri 64106
Phone: 816-374-5333

REGION 7 -- Arkansas, Louisiana, New Mexico, Oklahoma, Texas

Room 1414, 1114 Commerce Street
Dallas, Texas 75202
Phone: 214-749-3989 or 749-3980

REGION 8 -- Colorado, Idaho, Montana, Utah, Wyoming

Federal Office Building
19th and Stout Streets
Denver, Colorado 80202
Phone: 303-297-4682

REGION 9 -- Alaska, Arizona, California, Hawaii, Nevada, Oregon, Washington, Guam, American Samoa

Federal Office Building
50 Fulton Street
San Francisco, California 94102
Phone: 415-556-4811 or 556-5079

APPENDIX C
OUTPUT FROM A SAMPLE RUN OF THE AQDM PROGRAM

TEST CITY

SOURCE DATA

SOURCE NUMBER	SOURCE LOCATION (KILOMETERS)		SOURCE AREA SQUARE KILOMETERS	ANNUAL SOURCE EMISSION RATE (TONS/DAY)		STACK DATA			
	HORIZONTAL	VERTICAL		SO2	PART	HT (M)	DIAM (M)	VEL (M/SEC)	TEMP (DEG.K)
1	568.5	4403.4	0.0	130.000	50.250	150.0	0.0	0.0	0.
2	584.2	4391.6	0.0	150.510	75.200	90.0	8.7	15.2	422.
3	577.0	4401.1	0.0	21.120	3.250	30.0	0.7	17.8	788.
4	574.1	4401.5	0.0	10.500	5.150	23.0	1.4	15.2	533.
5	562.5	4402.5	25.00	0.130	0.160	0.0	0.0	0.0	0.
6	567.5	4402.5	25.00	0.120	0.170	0.0	0.0	0.0	0.
7	572.5	4402.5	25.00	0.500	0.380	10.0	0.0	0.0	0.
8	577.5	4402.5	25.00	0.140	1.250	0.0	0.0	0.0	0.
9	582.5	4402.5	25.00	0.110	0.150	0.0	0.0	0.0	0.
10	562.5	4397.5	25.00	0.250	0.140	10.0	0.0	0.0	0.
11	570.0	4395.0	100.00	3.110	2.010	15.0	0.0	0.0	0.
12	577.5	4397.5	25.00	0.520	0.380	10.0	0.0	0.0	0.
13	582.5	4397.5	25.00	0.630	0.550	10.0	0.0	0.0	0.
14	562.5	4392.5	25.00	0.250	0.110	10.0	0.0	0.0	0.
15	577.5	4392.5	25.00	0.750	0.490	20.0	0.0	0.0	0.
16	582.5	4392.5	25.00	0.500	0.350	10.0	0.0	0.0	0.
17	562.5	4387.5	25.00	0.260	0.130	0.0	0.0	0.0	0.
18	567.5	4387.5	25.00	0.230	0.180	10.0	0.0	0.0	0.
19	572.5	4387.5	25.00	0.510	0.390	10.0	0.0	0.0	0.
20	577.5	4387.5	25.00	0.530	0.370	10.0	0.0	0.0	0.
21	582.5	4387.5	25.00	0.270	0.140	10.0	0.0	0.0	0.

```
TEST CITY


RECEPTOR DATA

LOCATIONS TO BE USED AS RECEPTORS IN ADDITION TO THE 100 RECTANGULAR GRID LOCATIONS

  RECEPTOR        X-COORDINATE        Y-COORDINATE
   NUMBER         (KILOMETERS)        (KILOMETERS)

     101             562.0               4395.7

     102             566.1               4400.0

     103             570.0               4393.2

     104             573.9               4388.9

     105             572.5               4396.7

     106             572.4               4402.2

     107             579.0               4394.0

     108             577.5               4397.5

     109             576.0               4403.0

     110             582.5               4392.5

     111             583.0               4399.2

     112             582.5               4402.5
```

```
                    TEST CITY

               METEOROLOGICAL INPUT DATA FOR THE ANNUAL SEASON


MIXING DEPTH = 1000. METERS
AMBIENT TEMPERATURE =  288. DEGREES,KELVIN
AMBIENT PRESSURE = 1000. MILLIBARS


STABILITY CLASS  1
                                              WINDSPEED CLASS

  WIND DIRECTION        1         2         3         4         5         6

      N                0.0       0.0       0.0       0.0       0.0       0.0

      NNE              0.0       0.0       0.0       0.0       0.0       0.0

      NE               0.0       0.0       0.0       0.0       0.0       0.0

      ENE              0.0       0.0       0.0       0.0       0.0       0.0

      E                0.0       0.0       0.0       0.0       0.0       0.0

      ESE              0.0       0.0       0.0       0.0       0.0       0.0

      SE               0.0       0.0       0.0       0.0       0.0       0.0

      SSE              0.0       0.0       0.0       0.0       0.0       0.0

      S                0.0       0.0       0.0       0.0       0.0       0.0

      SSW              0.0       0.0       0.0       0.0       0.0       0.0

      SW               0.0       0.0       0.0       0.0       0.0       0.0

      WSW              0.0       0.0       0.0       0.0       0.0       0.0

      W                0.0       0.0       0.0       0.0       0.0       0.0

      WNW              0.0       0.0       0.0       0.0       0.0       0.0

      NW               0.0       0.0       0.0       0.0       0.0       0.0

      NNW              0.0       0.0       0.0       0.0       0.0       0.0
```

TEST CITY

METEOROLOGICAL INPUT DATA FOR THE ANNUAL SEASON

STABILITY CLASS 2

	WINDSPEED CLASS					
WIND DIRECTION	1	2	3	4	5	6
N	0.0005	0.0005	0.0	0.0	0.0	0.0
NNE	0.0	0.0	0.0	0.0	0.0	0.0
NE	0.0	0.0005	0.0	0.0	0.0	0.0
ENE	0.0005	0.0	0.0	0.0	0.0	0.0
E	0.0009	0.0005	0.0005	0.0	0.0	0.0
ESE	0.0009	0.0	0.0	0.0	0.0	0.0
SE	0.0009	0.0005	0.0	0.0	0.0	0.0
SSE	0.0	0.0	0.0	0.0	0.0	0.0
S	0.0	0.0	0.0	0.0	0.0	0.0
SSW	0.0	0.0	0.0	0.0	0.0	0.0
SW	0.0	0.0	0.0	0.0	0.0	0.0
WSW	0.0009	0.0	0.0	0.0	0.0	0.0
W	0.0	0.0005	0.0	0.0	0.0	0.0
WNW	0.0005	0.0	0.0	0.0	0.0	0.0
NW	0.0	0.0	0.0	0.0	0.0	0.0
NNW	0.0	0.0	0.0	0.0	0.0	0.0

TEST CITY

METEOROLOGICAL INPUT DATA FOR THE ANNUAL SEASON

STABILITY CLASS 3

			WINDSPEED CLASS			
WIND DIRECTION	1	2	3	4	5	6
N	0.0005	0.0	0.0032	0.0	0.0	0.0
NNE	0.0	0.0005	0.0009	0.0	0.0	0.0
NE	0.0	0.0	0.0009	0.0	0.0	0.0
ENE	0.0009	0.0009	0.0046	0.0	0.0	0.0
E	0.0018	0.0028	0.0041	0.0005	0.0	0.0
ESE	0.0	0.0037	0.0046	0.0	0.0	0.0
SE	0.0014	0.0032	0.0028	0.0	0.0	0.0
SSE	0.0	0.0028	0.0009	0.0	0.0	0.0
S	0.0	0.0009	0.0009	0.0	0.0	0.0
SSW	0.0	0.0018	0.0009	0.0	0.0	0.0
SW	0.0	0.0018	0.0009	0.0	0.0	0.0
WSW	0.0005	0.0014	0.0009	0.0	0.0	0.0
W	0.0	0.0014	0.0009	0.0	0.0	0.0
WNW	0.0005	0.0005	0.0009	0.0	0.0	0.0
NW	0.0	0.0009	0.0005	0.0	0.0	0.0
NNW	0.0	0.0014	0.0014	0.0	0.0	0.0

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                    TEST CITY

          METECROLOGICAL INPUT DATA FOR THE ANNUAL SEASON


STABILITY CLASS  4
                                              WINDSPEED CLASS

  WIND DIRECTION         1          2          3          4          5          6

       N                0.0      0.0018     0.0526     0.0383     0.0037     0.0

       NNE              0.0      0.0009     0.0134     0.0157     0.0028     0.0

       NE               0.0      0.0009     0.0106     0.0148     0.0005     0.0

       ENE              0.0      0.0037     0.0106     0.0106     0.0005     0.0

       E                0.0      0.0056     0.0148     0.0138     0.0055     0.0014

       ESE              0.0      0.0028     0.0101     0.0507     0.0111     0.0014

       SE               0.0      0.0014     0.0217     0.0410     0.0051     0.0005

       SSE              0.0      0.0018     0.0175     0.0244     0.0028     0.0

       S                0.0      0.0005     0.0148     0.0300     0.0023     0.0

       SSW              0.0      0.0014     0.0088     0.0088     0.0        0.0

       SW               0.0      0.0018     0.0018     0.0        0.0        0.0

       WSW              0.0      0.0009     0.0088     0.0005     0.0        0.0

       W                0.0      0.0041     0.0129     0.0069     0.0        0.0

       WNW              0.0      0.0037     0.0157     0.0111     0.0018     0.0

       NW               0.0      0.0023     0.0244     0.0161     0.0028     0.0

       NNW              0.0      0.0028     0.0300     0.0327     0.0023     0.0
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                TEST CITY

           METEOROLOGICAL INPUT DATA FOR THE ANNUAL SEASON

STABILITY CLASS  5
                                              WINDSPEED CLASS
  WIND DIRECTION        1         2         3        4         5         6
      N              0.0051    0.0124    0.0212    0.0      0.0       0.0
      NNE            0.0005    0.0028    0.0046    0.0      0.0       0.0
      NE             0.0009    0.0051    0.0028    0.0      0.0       0.0
      ENE            0.0032    0.0078    0.0041    0.0      0.0       0.0
      E              0.0106    0.0161    0.0055    0.0      0.0       0.0
      ESE            0.0055    0.0161    0.0124    0.0      0.0       0.0
      SE             0.0014    0.0069    0.0046    0.0      0.0       0.0
      SSE            0.0009    0.0051    0.0051    0.0      0.0       0.0
      S              0.0028    0.0046    0.0023    0.0      0.0       0.0
      SSW            0.0051    0.0065    0.0       0.0      0.0       0.0
      SW             0.0009    0.0037    0.0       0.0      0.0       0.0
      WSW            0.0018    0.0037    0.0       0.0      0.0       0.0
      W              0.0018    0.0065    0.0005    0.0      0.0       0.0
      WNW            0.0055    0.0120    0.0037    0.0      0.0       0.0
      NW             0.0088    0.0111    0.0037    0.0      0.0       0.0
      NNW            0.0032    0.0115    0.0069    0.0      0.0       0.0
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TEST CITY

RECEPTOR INFORMATION FOR STATISTICAL OUTPUT

_____________SO2______________             _________PARTICULATES_________
SELECTED     STANDARD GEOMETRIC            SELECTED     STANDARD GEOMETRIC
RECEPTOR     DEVIATION (24 HR.             RECEPTOR     DEVIATION (24 HR.
  NO.        AVERAGING TIME)                 NO.        AVERAGING TIME)


   34             1.80                        55              1.70
   55             1.90                        64              1.70
   64             1.80                       101              1.70
  101             1.81                       102              1.67
  102             1.79                       103              1.72
  103             1.83                       104              1.65
  104             1.77                       105              1.72
  106             2.35                       106              2.01
  107             1.96                       107              1.82
  109             2.30                       109              2.00
  111             1.92                       111              1.80
  112             1.90                       112              1.80
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     TEST CITY


REGRESSION PARAMETERS FOR CALCULATED (X-AXIS) VS. OBSERVED (Y-AXIS) CONCENTRATIONS
     POLLUTANT           Y-INTERCEPT             SLOPE         REGRESSION COEFFICIENTS
    -----------    (MICROGRAMS/CU. METER)      --------     COMPUTED      5% CONF. LEVEL

    SO2                      0.2               0.5132         0.989          0.754
    PARTICULATES            -0.0               0.7020         0.962          0.707
```

TEST CITY

CORRELATION DATA

SO2 MONITORING STATION	RECEPTOR LOCATION (KILOMETERS) HORIZONTAL	VERTICAL	SO2 CONCENTRATION (MICROGRAMS/CU. METER) OBSERVED	CALCULATED
1	562.0	4395.7	10.	18.
2	566.1	4400.0	18.	34.
3	570.0	4393.2	12.	31.
4	573.9	4388.9	14.	26.
5	572.4	4402.2	50.	97.
6	579.0	4394.0	20.	36.
7	583.0	4399.2	16.	28.

TEST CITY

CORRELATION DATA

PARTICULATE MONITORING STATION	RECEPTOR LOCATION (KILOMETERS)		PARTICULATE CONCENTRATION (MICROGRAMS/CU. METER)	
	HORIZONTAL	VERTICAL	OBSERVED	CALCULATED
1	562.0	4395.7	6.	8.
2	566.1	4400.0	10.	13.
3	570.0	4393.2	8.	14.
4	573.9	4388.9	11.	11.
5	572.5	4396.7	9.	16.
6	572.4	4402.2	26.	36.
7	579.0	4394.0	8.	13.
8	583.0	4399.2	7.	10.

TEST CITY

RECEPTOR CONCENTRATION DATA

RECEPTOR NUMBER	RECEPTOR LOCATION (KILOMETERS) HORIZ	RECEPTOR LOCATION (KILOMETERS) VERT	EXPECTED ARITHMETIC MEAN (MICROGRAMS/CU. METER) SO2	EXPECTED ARITHMETIC MEAN (MICROGRAMS/CU. METER) PARTICULATES
1	550.0	4372.5	3.	2.
2	550.0	4377.5	3.	2.
3	550.0	4382.5	4.	2.
4	550.0	4387.5	5.	3.
5	550.0	4392.5	6.	4.
6	550.0	4397.5	8.	4.
7	550.0	4402.5	9.	5.
8	550.0	4407.5	9.	5.
9	550.0	4412.5	9.	5.
10	550.0	4417.5	7.	4.
11	555.0	4372.5	3.	2.
12	555.0	4377.5	3.	2.
13	555.0	4382.5	4.	3.
14	555.0	4387.5	5.	3.
15	555.0	4392.5	6.	4.
16	555.0	4397.5	9.	5.
17	555.0	4402.5	12.	6.
18	555.0	4407.5	12.	7.
19	555.0	4412.5	10.	6.
20	555.0	4417.5	8.	5.
21	560.0	4372.5	4.	2.
22	560.0	4377.5	4.	3.
23	560.0	4382.5	4.	3.
24	560.0	4387.5	6.	4.
25	560.0	4392.5	7.	5.
26	560.0	4397.5	11.	6.
27	560.0	4402.5	16.	9.
28	560.0	4407.5	16.	9.
29	560.0	4412.5	12.	7.
30	560.0	4417.5	8.	5.
31	565.0	4372.5	5.	3.
32	565.0	4377.5	6.	4.
33	565.0	438[illegible].5	7.	4.
34	565.0	4387.5	9.	5.
35	565.0	4392.5	10.	6.
36	565.0	4397.5	13.	8.
37	565.0	4402.5	24.	13.
38	565.0	4407.5	22.	12.
39	565.0	4412.5	11.	6.
40	565.0	4417.5	8.	5.

TEST CITY

RECEPTOR CONCENTRATION DATA

RECEPTOR NUMBER	RECEPTOR LOCATION		EXPECTED ARITHMETIC MEAN	
	(KILOMETERS)		(MICROGRAMS/CU. METER)	
	HORIZ	VERT	SO2	PARTICULATES
41	570.0	4372.5	7.	4.
42	570.0	4377.5	8.	5.
43	570.0	4382.5	9.	5.
44	570.0	4387.5	11.	7.
45	570.0	4392.5	16.	9.
46	570.0	4397.5	23.	13.
47	570.0	4402.5	27.	13.
48	570.0	4407.5	14.	8.
49	570.0	4412.5	10.	6.
50	570.0	4417.5	7.	4.
51	575.0	4372.5	8.	4.
52	575.0	4377.5	9.	5.
53	575.0	4382.5	11.	6.
54	575.0	4387.5	13.	7.
55	575.0	4392.5	18.	10.
56	575.0	4397.5	24.	14.
57	575.0	4402.5	44.	16.
58	575.0	4407.5	11.	6.
59	575.0	4412.5	7.	4.
60	575.0	4417.5	6.	3.
61	580.0	4372.5	8.	5.
62	580.0	4377.5	9.	5.
63	580.0	4382.5	10.	5.
64	580.0	4387.5	12.	6.
65	580.0	4392.5	14.	8.
66	580.0	4397.5	24.	10.
67	580.0	4402.5	13.	7.
68	580.0	4407.5	9.	5.
69	580.0	4412.5	7.	3.
70	580.0	4417.5	5.	3.
71	585.0	4372.5	8.	5.
72	585.0	4377.5	8.	5.
73	585.0	4382.5	9.	5.
74	585.0	4387.5	9.	5.
75	585.0	4392.5	11.	5.
76	585.0	4397.5	12.	6.
77	585.0	4402.5	8.	5.
78	585.0	4407.5	5.	3.
79	585.0	4412.5	5.	3.
80	585.0	4417.5	4.	3.

TEST CITY

RECEPTOR CONCENTRATION DATA

RECEPTOR NUMBER	RECEPTOR LOCATION (KILOMETERS) HORIZ	VERT	EXPECTED ARITHMETIC MEAN (MICROGRAMS/CU. METER) SO2	PARTICULATES
81	590.0	4372.5	6.	4.
82	590.0	4377.5	7.	4.
83	590.0	4382.5	8.	4.
84	590.0	4387.5	8.	4.
85	590.0	4392.5	8.	4.
86	590.0	4397.5	7.	4.
87	590.0	4402.5	5.	3.
88	590.0	4407.5	4.	3.
89	590.0	4412.5	3.	2.
90	590.0	4417.5	3.	2.
91	595.0	4372.5	6.	4.
92	595.0	4377.5	6.	4.
93	595.0	4382.5	6.	4.
94	595.0	4387.5	7.	4.
95	595.0	4392.5	6.	3.
96	595.0	4397.5	5.	3.
97	595.0	4402.5	4.	2.
98	595.0	4407.5	3.	2.
99	595.0	4412.5	3.	2.
100	595.0	4417.5	2.	2.
101	562.0	4395.7	10.	6.
102	566.1	4400.0	17.	9.
103	570.0	4393.2	16.	10.
104	573.9	4388.9	13.	8.
105	572.5	4396.7	19.	11.
106	572.4	4402.2	50.	25.
107	579.0	4394.0	19.	9.
108	577.5	4397.5	37.	14.
109	576.0	4403.0	32.	12.
110	582.5	4392.5	12.	6.
111	583.0	4399.2	15.	7.
112	582.5	4402.5	10.	5.

TEST CITY

STATISTICAL DATA FOR SELECTED RECEPTORS

ANNUAL SO2

MICROGRAMS PER CUBIC METER

AVERAGING TIME 1. HOURS

RECEPTOR NUMBER	EXPECTED ARITHMETIC MEAN	EXPECTED GEOMETRIC MEAN	EXPECTED MAXIMUM CONCENTRATION	STANDARD GEOMETRIC DEVIATION
34	9.	7.	106.	2.07
55	18.	13.	268.	2.22
64	12.	9.	142.	2.07
101	10.	7.	122.	2.09
102	17.	13.	212.	2.06
103	16.	12.	216.	2.12
104	13.	10.	155.	2.03
106	50.	28.	1620.	2.89
107	19.	13.	316.	2.30
109	32.	19.	968.	2.81
111	15.	11.	230.	2.25
112	10.	7.	153.	2.22

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TEST CITY

STATISTICAL DATA FOR SELECTED RECEPTORS

ANNUAL   SO2

MICROGRAMS PER CUBIC METER

AVERAGING TIME   8. HOURS

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|          |  EXPECTED    |  EXPECTED    |    EXPECTED      |  STANDARD       |
| RECEPTOR |  ARITHMETIC  |  GECMETRIC   |    MAXIMUM       |  GEOMETRIC      |
| NUMBER   |    MEAN      |    MEAN      |  CONCENTRATION   |  DEVIATION      |
|          |              |              |                  |                 |
|    34    |      9.      |      7.      |       56.        |      1.90       |
|          |              |              |                  |                 |
|    55    |     18.      |     14.      |      136.        |      2.01       |
|          |              |              |                  |                 |
|    64    |     12.      |      9.      |       76.        |      1.90       |
|          |              |              |                  |                 |
|   101    |     10.      |      8.      |       65.        |      1.91       |
|          |              |              |                  |                 |
|   102    |     17.      |     14.      |      113.        |      1.89       |
|          |              |              |                  |                 |
|   103    |     16.      |     13.      |      113.        |      1.93       |
|          |              |              |                  |                 |
|   104    |     13.      |     11.      |       84.        |      1.86       |
|          |              |              |                  |                 |
|   106    |     50.      |     32.      |      676.        |      2.54       |
|          |              |              |                  |                 |
|   107    |     19.      |     14.      |      155.        |      2.08       |
|          |              |              |                  |                 |
|   109    |     32.      |     21.      |      411.        |      2.48       |
|          |              |              |                  |                 |
|   111    |     15.      |     11.      |      115.        |      2.03       |
|          |              |              |                  |                 |
|   112    |     10.      |      8.      |       77.        |      2.01       |
|          |              |              |                  |                 |
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TEST CITY

STATISTICAL DATA FOR SELECTED RECEPTORS

ANNUAL SO2

MICROGRAMS PER CUBIC METER

AVERAGING TIME 24. HOURS

RECEPTOR NUMBER	EXPECTED ARITHMETIC MEAN	EXPECTED GEOMETRIC MEAN	EXPECTED MAXIMUM CONCENTRATION	STANDARD GEOMETRIC DEVIATION
34	9.	7.	40.	1.80
55	18.	14.	95.	1.90
64	12.	10.	54.	1.80
101	10.	8.	46.	1.81
102	17.	15.	82.	1.79
103	16.	14.	81.	1.83
104	13.	11.	61.	1.77
106	50.	35.	427.	2.35
107	19.	15.	107.	1.96
109	32.	23.	263.	2.30
111	15.	12.	80.	1.92
112	10.	8.	54.	1.90

TEST CITY

STATISTICAL DATA FOR SELECTED RECEPTORS

ANNUAL PARTICULATES

MICROGRAMS PER CUBIC METER

AVERAGING TIME 4. HOURS

RECEPTOR NUMBER	EXPECTED ARITHMETIC MEAN	EXPECTED GECMETRIC MEAN	EXPECTED MAXIMUM CONCENTRATION	STANDARD GEOMETRIC DEVIATION
95	10.	8.	66.	1.83
64	6.	5.	42.	1.83
101	6.	5.	39.	1.83
102	9.	8.	58.	1.80
103	10.	8.	68.	1.86
104	8.	7.	48.	1.77
105	11.	9.	80.	1.86
106	25.	18.	290.	2.22
107	9.	7.	76.	1.98
109	12.	9.	141.	2.21
111	7.	6.	56.	1.96
112	5.	4.	44.	1.96

TEST CITY

STATISTICAL DATA FOR SELECTED RECEPTORS

ANNUAL PARTICULATES

MICROGRAMS PER CUBIC METER

AVERAGING TIME 8. HOURS

RECEPTOR NUMBER	EXPECTED ARITHMETIC MEAN	EXPECTED GEOMETRIC MEAN	EXPECTED MAXIMUM CONCENTRATION	STANDARD GEOMETRIC DEVIATION
55	10.	8.	54.	1.78
64	6.	5.	35.	1.78
101	6.	5.	32.	1.78
102	9.	8.	48.	1.75
103	10.	8.	56.	1.81
104	8.	7.	40.	1.73
105	11.	10.	66.	1.81
106	25.	19.	227.	2.14
107	9.	7.	61.	1.92
109	12.	9.	110.	2.13
111	7.	6.	46.	1.90
112	5.	4.	36.	1.90

TEST CITY

STATISTICAL DATA FOR SELECTED RECEPTORS

ANNUAL PARTICULATES

MICROGRAMS PER CUBIC METER

AVERAGING TIME 24. HOURS

RECEPTOR NUMBER	EXPECTED ARITHMETIC MEAN	EXPECTED GEOMETRIC MEAN	EXPECTED MAXIMUM CONCENTRATION	STANDARD GEOMETRIC DEVIATION
55	10.	8.	40.	1.70
64	6.	5.	26.	1.70
101	6.	5.	24.	1.70
102	9.	8.	36.	1.67
103	10.	8.	41.	1.72
104	8.	7.	30.	1.65
105	11.	10.	42.	1.72
106	25.	20.	154.	2.01
107	9.	8.	44.	1.82
109	12.	10.	75.	2.00
111	7.	6.	33.	1.80
112	5.	5.	26.	1.80

TEST CITY

SOURCE CONTRIBUTIONS TO FIVE SELECTED RECEPTORS

ANNUAL SO2

MICROGRAMS PER CUBIC METER

SOURCE	RECEPTOR 46	RECEPTOR 55	RECEPTOR 109	RECEPTOR 110	RECEPTOR 111
1	53.54 % 12.5644	29.54 % 5.2241	13.52 % 4.3399	21.69 % 2.6163	17.50 % 2.5532
2	9.94 % 2.3329	8.78 % 1.5533	5.36 % 1.7215	0.40 % 0.0487	6.94 % 1.0131
3	18.03 % 4.2319	28.83 % 5.0986	68.00 % 21.8302	47.66 % 5.7502	52.15 % 7.6111
4	6.50 % 1.5260	16.86 % 2.9812	6.86 % 2.2021	9.17 % 1.1064	9.01 % 1.3143
5	0.12 % 0.0292	0.12 % 0.0211	0.04 % 0.0125	0.11 % 0.0136	0.06 % 0.0090
6	0.18 % 0.0417	0.14 % 0.0255	0.05 % 0.0161	0.13 % 0.0159	0.09 % 0.0132
7	0.52 % 0.1231	0.67 % 0.1181	0.22 % 0.0712	0.82 % 0.0993	0.57 % 0.0833
8	0.09 % 0.0208	0.13 % 0.0236	0.31 % 0.0995	0.27 % 0.0325	0.26 % 0.0386
9	0.07 % 0.0166	0.06 % 0.0101	0.11 % 0.0352	0.21 % 0.0251	0.24 % 0.0351
10	0.17 % 0.0404	0.23 % 0.0415	0.04 % 0.0141	0.17 % 0.0207	0.10 % 0.0140
11	3.02 % 0.7087	2.82 % 0.4996	0.65 % 0.2073	2.46 % 0.2971	1.17 % 0.1713
12	0.68 % 0.1589	0.72 % 0.1275	0.35 % 0.1123	1.30 % 0.1568	0.55 % 0.0806
13	0.65 % 0.1533	0.53 % 0.0932	0.45 % 0.1435	1.66 % 0.2004	2.57 % 0.3750
14	0.09 % 0.0201	0.15 % 0.0261	0.03 % 0.0105	0.14 % 0.0171	0.06 % 0.0094
15	0.74 % 0.1743	2.18 % 0.3864	0.29 % 0.0920	1.21 % 0.1459	0.49 % 0.0721
16	0.48 % 0.1128	0.86 % 0.1522	0.20 % 0.0628	2.96 % 0.3576	0.55 % 0.0802
17	0.09 % 0.0201	0.09 % 0.0154	0.03 % 0.0111	0.08 % 0.0100	0.05 % 0.0069
18	0.11 % 0.0264	0.10 % 0.0184	0.05 % 0.0151	0.10 % 0.0117	0.05 % 0.0078
19	0.27 % 0.0635	0.45 % 0.0789	0.14 % 0.0434	0.28 % 0.0337	0.20 % 0.0286
20	0.30 % 0.0712	0.75 % 0.1323	0.14 % 0.0456	0.49 % 0.0588	0.34 % 0.0500
21	0.15 % 0.0342	0.35 % 0.0627	0.07 % 0.0225	0.42 % 0.0509	0.21 % 0.0303

TEST CITY

SOURCE CONTRIBUTIONS TO FIVE SELECTED RECEPTORS

ANNUAL SO2

MICROGRAMS PER CUBIC METER

SOURCE	RECEPTOR 46	RECEPTOR 55	RECEPTOR 109	RECEPTOR 110	RECEPTOR 111
BACK-GROUND	4.26 % 1.	5.65 % 1.	3.11 % 1.	8.29 % 1.	6.85 % 1.
TOTAL	100.0 % 23.4706	100.0 % 17.6899	100.0 % 32.1082	100.0 % 12.0687	100.0 % 14.5971

TEST CITY

SOURCE CONTRIBUTIONS TO FIVE SELECTED RECEPTORS

ANNUAL PARTICULATES

MICROGRAMS PER CUBIC METER

SOURCE	RECEPTOR 105	RECEPTOR 109	RECEPTOR 110	RECEPTOR 111	RECEPTOR 112
1	37.44 % 4.2455	18.04 % 2.2529	21.92 % 1.3343	18.82 % 1.3075	22.03 % 1.2033
2	14.14 % 1.6035	9.25 % 1.1551	0.53 % 0.0321	9.65 % 0.6706	14.77 % 0.8070
3	6.08 % 0.6897	36.12 % 4.5114	19.18 % 1.1675	22.34 % 1.5517	14.23 % 0.7775
4	15.68 % 1.7777	11.61 % 1.4505	11.76 % 0.7160	12.29 % 0.8540	10.44 % 0.5705
5	0.37 % 0.0416	0.17 % 0.0207	0.36 % 0.0221	0.21 % 0.0147	0.26 % 0.0143
6	0.59 % 0.0666	0.25 % 0.0306	0.49 % 0.0296	0.36 % 0.0248	0.38 % 0.0205
7	1.38 % 0.1568	0.58 % 0.0727	1.64 % 0.0996	1.21 % 0.0838	1.14 % 0.0625
8	2.49 % 0.2820	9.55 % 1.1926	6.30 % 0.3833	6.57 % 0.4567	5.87 % 0.3206
9	0.24 % 0.0273	0.52 % 0.0644	0.74 % 0.0452	0.91 % 0.0635	2.60 % 0.1419
10	0.23 % 0.0261	0.08 % 0.0106	0.25 % 0.0153	0.15 % 0.0104	0.13 % 0.0070
11	4.99 % 0.5662	1.44 % 0.1799	4.16 % 0.2533	2.11 % 0.1467	2.22 % 0.1214
12	1.46 % 0.1655	0.88 % 0.1103	2.48 % 0.1512	1.12 % 0.0780	1.01 % 0.0552
13	1.59 % 0.1806	1.35 % 0.1683	3.79 % 0.2308	6.24 % 0.4337	2.49 % 0.1357
14	0.09 % 0.0105	0.05 % 0.0062	0.16 % 0.0099	0.08 % 0.0055	0.08 % 0.0046
15	1.58 % 0.1794	0.65 % 0.0807	2.07 % 0.1258	0.90 % 0.0624	1.15 % 0.0627
16	1.03 % 0.1164	0.47 % 0.0590	5.43 % 0.3303	1.07 % 0.0743	1.07 % 0.0586
17	0.09 % 0.0105	0.06 % 0.0075	0.11 % 0.0066	0.07 % 0.0046	0.07 % 0.0039
18	0.21 % 0.0241	0.13 % 0.0159	0.20 % 0.0121	0.12 % 0.0081	0.17 % 0.0093
19	0.64 % 0.0722	0.36 % 0.0445	0.56 % 0.0340	0.42 % 0.0289	0.51 % 0.0276
20	0.61 % 0.0687	0.34 % 0.0427	0.89 % 0.0542	0.67 % 0.0463	0.74 % 0.0405
21	0.25 % 0.0278	0.13 % 0.0157	0.57 % 0.0348	0.30 % 0.0208	0.33 % 0.0179

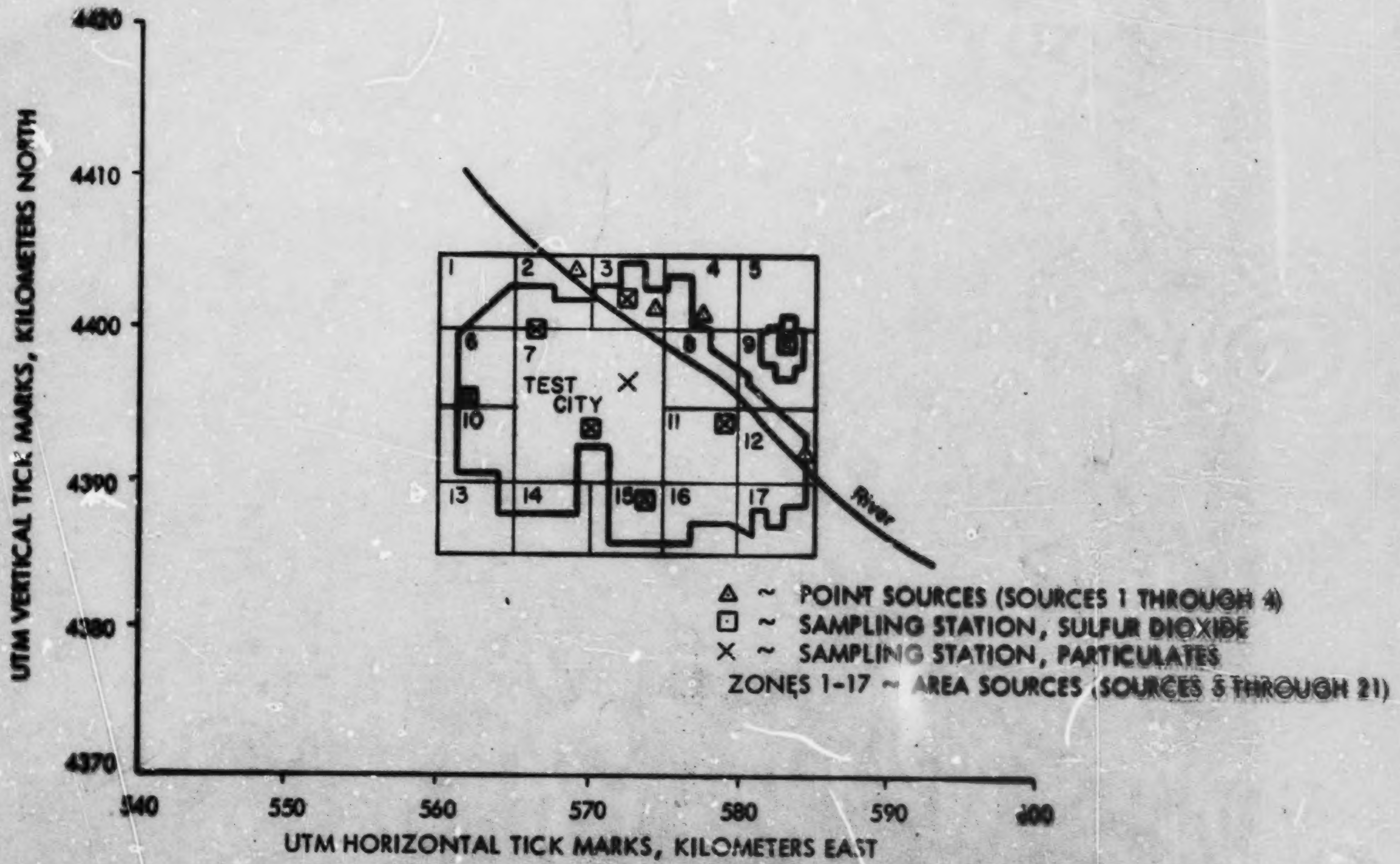
TEST CITY

SOURCE CONTRIBUTIONS TO FIVE SELECTED RECEPTORS

ANNUAL PARTICULATES

MICROGRAMS PER CUBIC METER

SOURCE	RECEPTOR 105	RECEPTOR 109	RECEPTOR 110	RECEPTOR 111	RECEPTOR 112
BACK-GROUND	8.82 % 1.	8.01 % 1.	16.43 % 1.	14.40 % 1.	18.31 % 1.
TOTAL	100.0 % 11.3387	100.0 % 12.4922	100.0 % 6.0880	100.0 % 6.9470	100.0 % 5.4627


4420
4410
4400
4390
4380
4370
UTM VERTICAL TICK MARKS, KILOMETERS NORTH
540
550
560
570
580
590
600
UTM HORIZONTAL TICK MARKS, KILOMETERS EAST
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
TEST CITY
River
△ ~ POINT SOURCES (SOURCES 1 THROUGH 4)
⊡ ~ SAMPLING STATION, SULFUR DIOXIDE
X ~ SAMPLING STATION, PARTICULATES
ZONES 1-17 ~ AREA SOURCES (SOURCES 5 THROUGH 21)

TEST CITY BASE MAP

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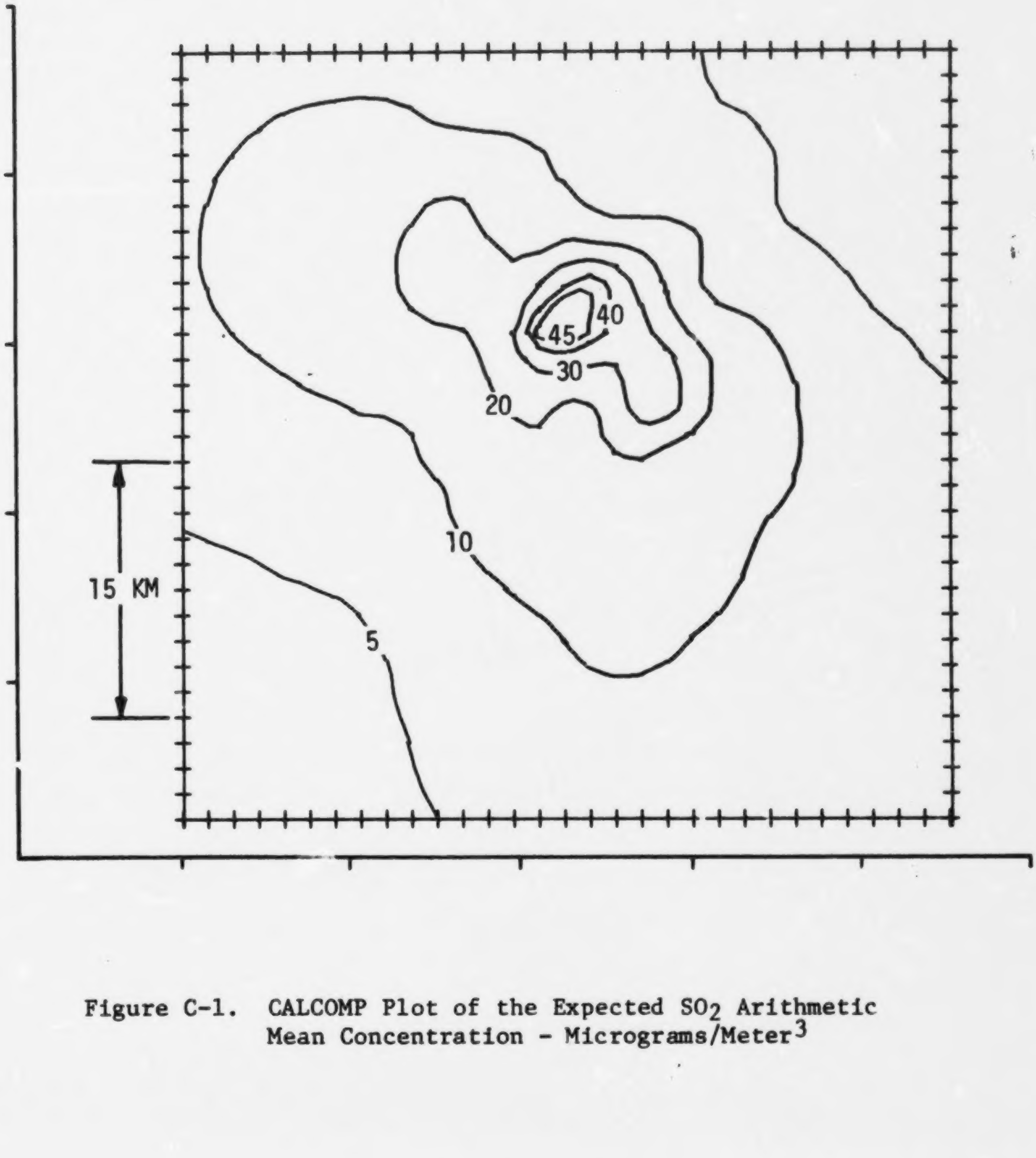

Figure C-1. CALCOMP Plot of the Expected SO_2 Arithmetic Mean Concentration - Micrograms/Meter^3

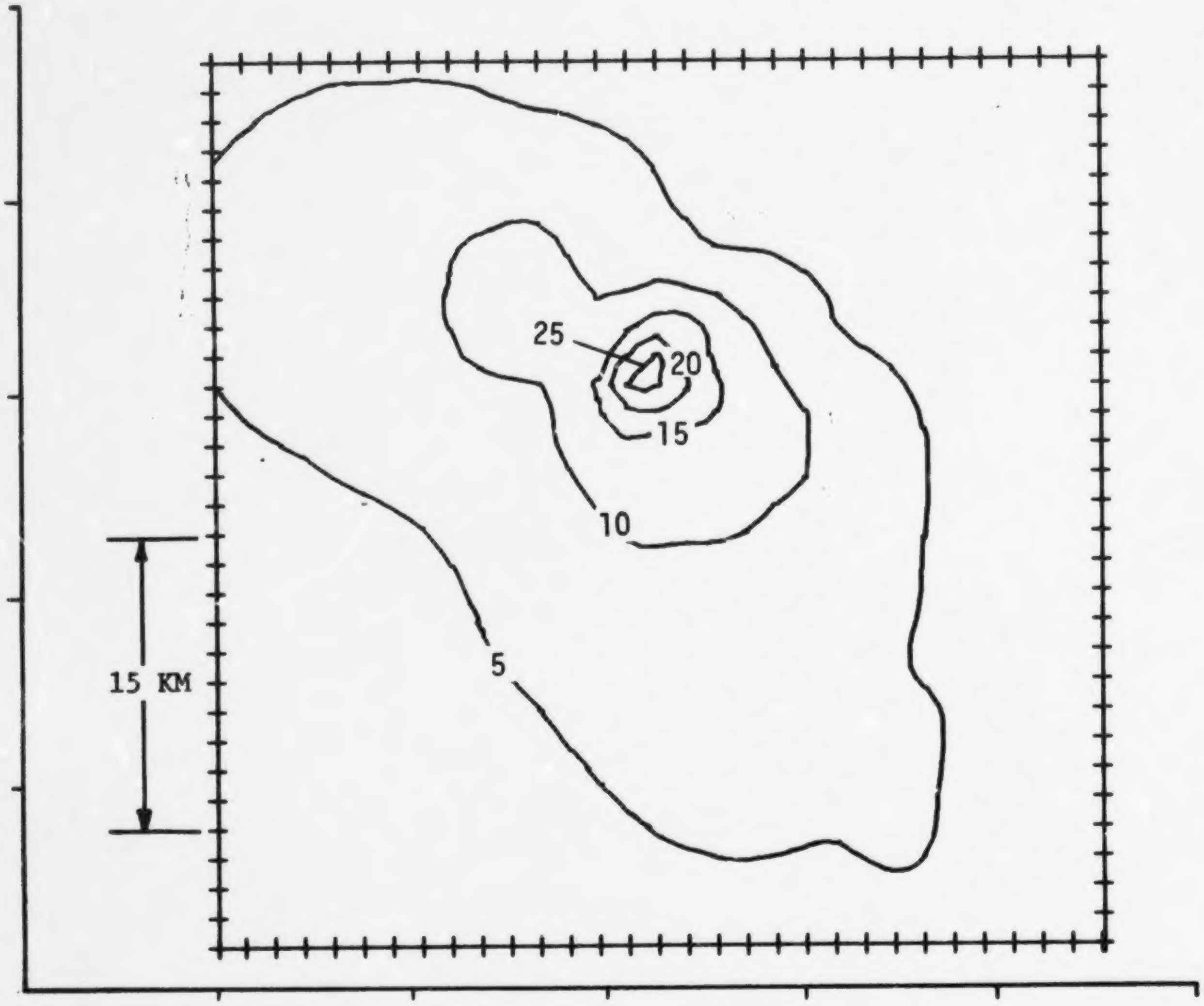

Figure C-2. CALCOMP Plot of the Expected Particulate Arithmetic Mean Concentration - Micrograms/Meter^3

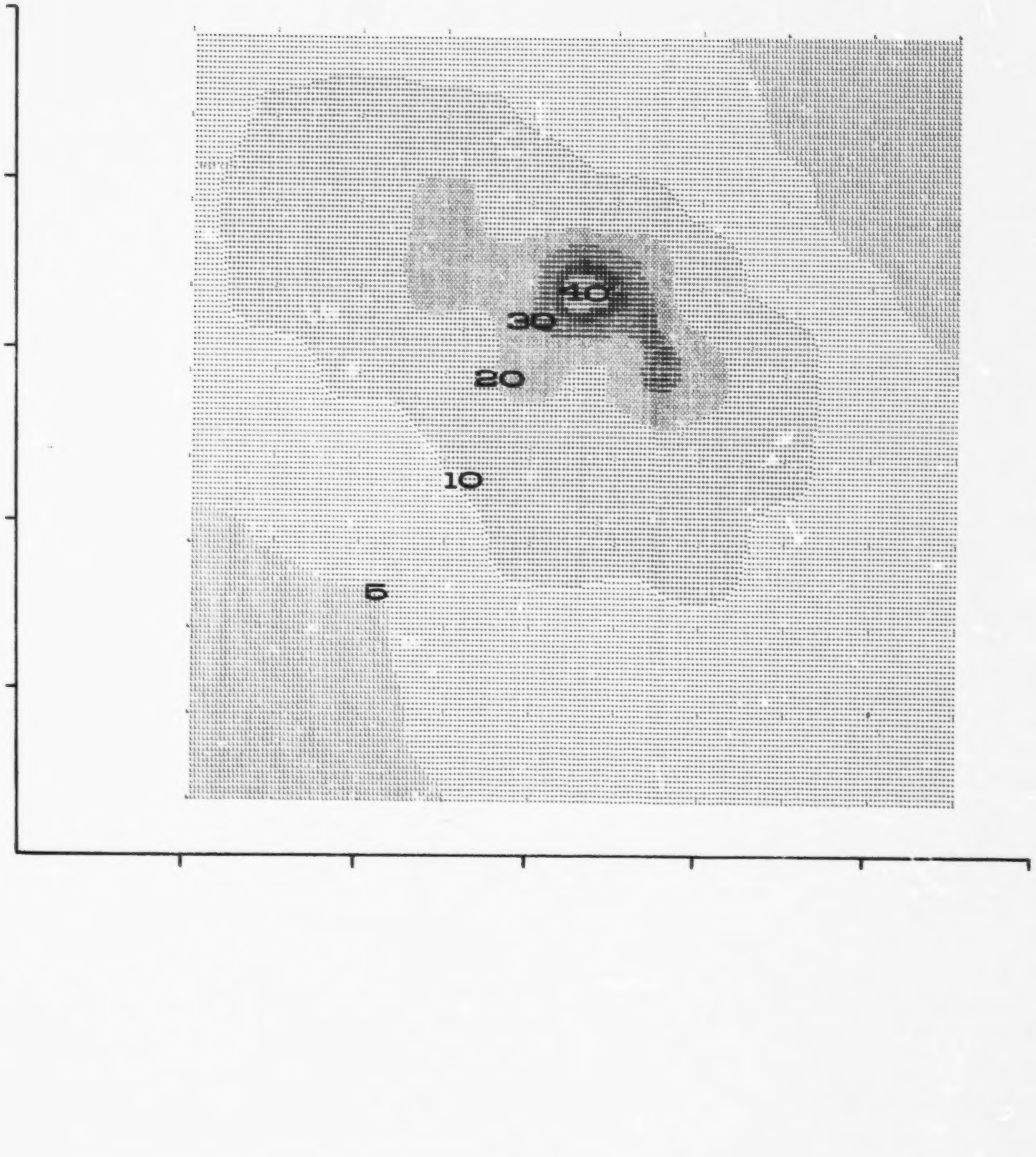

Figure C-3. SYMAP Plot of the Expected SO_2 Arithmetic Mean Concentration - Micrograms/Meter^3

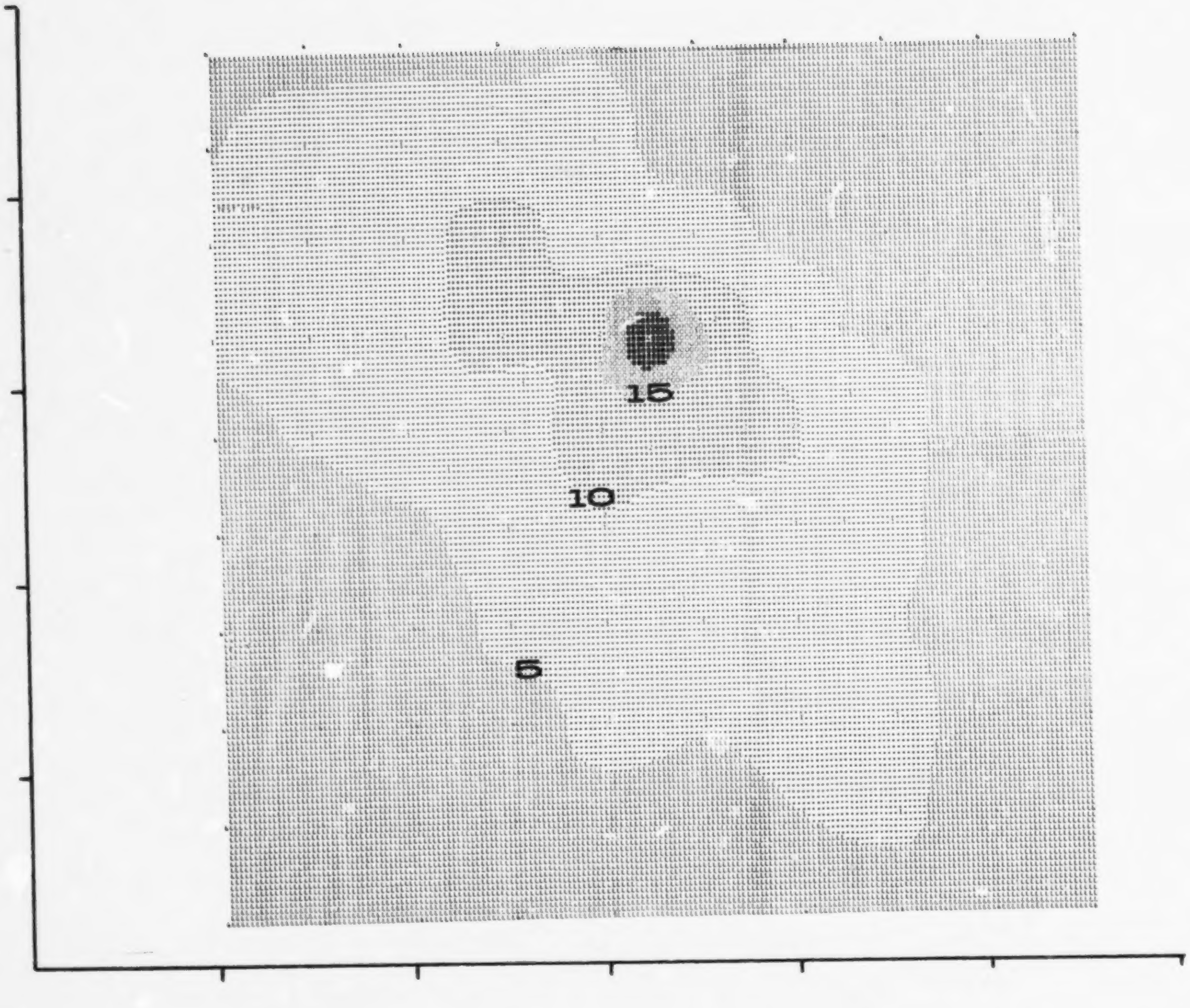

Figure C-4. SYMAP Plot of the Expected Particulate Arithmetic Mean Concentration - Micrograms/Meter^3

APPENDIX D
AQDM PROGRAM LISTING AND DOCUMENTATION

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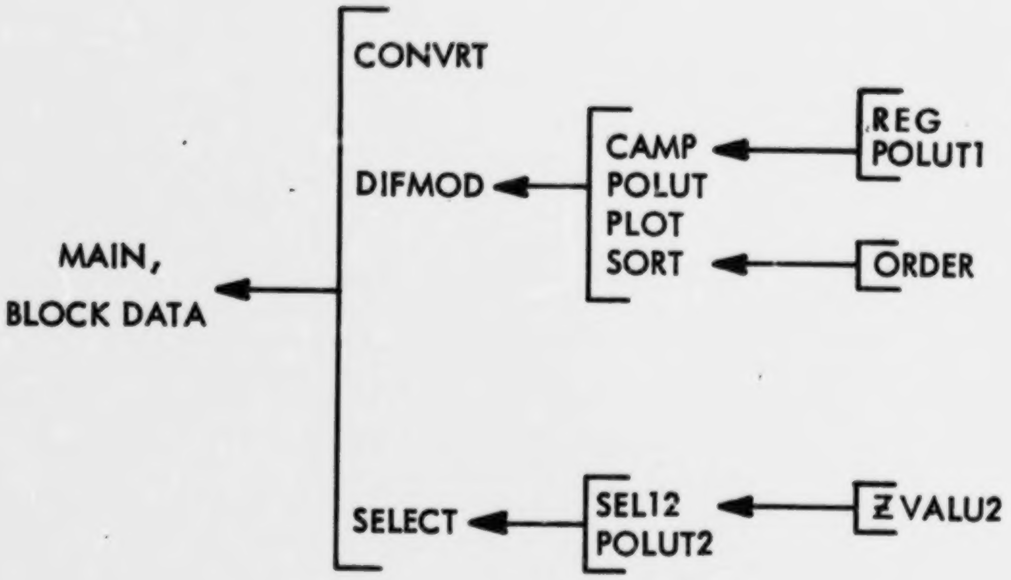
LIST OF SUBROUTINES

SUBROUTINE	DESCRIPTION	Page
BL0CK DATA	- initialization of variables and arrays.	D-3
CAMP	- a subdriver to compute the regression output.	D-6
C0NVRT	- conversion, translation and preprocessing of source data.	D-9
DIFM0D	- construction of receptor grid, a subdriver to compute ground-level concentration.	D-14
MAIN	- initialization of arrays and variables for multiple runs; the driver for all the subroutines.	D-19
0RDER	- sorting of N numbers and their indices in descending order	D-25
PL0T	- card punching routine for the IBM 1130 and a plotter. .	D-28
P0LUT	- computation and calibration of ground-level concentration	D-31
P0LUT1	- computation of ground-level concentration for CAMP stations.	D-47
P0LUT2	- computation of source contribution.	D-51
REG	- computation of y-intercept and the slope for calibration	D-55
SEL12	- computation of geometric mean, maximum concentration and concentrations for three percentiles for up to five averaging times.	D-60
SELECT	- computation of statistical data and source contribution percentage	D-65
S0RT	- a subdriver to sort ground-level concentration in descending order, selection of five maximum receptors or five selected receptors for source contribution computation	D-70
ZVALU2	- computation of reduced normal variate	D-74

OVERLAY STRUCTURE OF AQDM



BLOCK DATA

Purpose: To initialize variables in labeled common.

This is not an executable routine.

```
      BLOCK DATA
C
      LOGICAL SGTDMX
C                     FOR SIGZ GREATER THAN DMIX -- A LOGICAL VARIABLE
      COMMON /AIRQ/ AVRGTM(2,3),STANDV(2,12)
      COMMON /CONS/ PI4,PI8
      COMMON /CORD/ RBASE(2),DELTA,INCRX,INCRY,GDSCAL,USCALE
       COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /LITL/ REGION(18)
      COMMON /LOGI/ SGTDMX,IPNCH
      COMMON /RCPT/ RECEPT(2,237),CPCLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUTS(2,5),
     3              PTS(2,5)
      COMMON /REST/ A(7),B(7),C(7)
      COMMON /RGSN/ AC(2),BC(2),CORREL(100)
      COMMON /SELC/ ISEL12(2,12),NSEL12,ISEL5(2,5),NSEL5,XP(2,12)
      COMMON /SRCE/ SORCE(6,1000),PLUME(3,1000),CS(2,1000),BACKGR(2),
     1              IFLAG,NSORCE,TA,PA
      COMMON /WIND/ WNDFRQ(6,16,5),UU(6),SINWD(16),COSWD(16),DPTHMX
C
C     ***************************DATA STATEMENTS*****************************
C
      DATA COSWD/1.0,.92388,.70711,.38268,0.0,-.38268,-.70711,-.92388,
     1    -1.0,-.92388,-.70711,-.38268,0.0,.38268,.70711,.92388/
C
C     COSWD(IWNDIR)=COS((PI*FLOAT(IWNDIR-1))/8)
C
      DATA SINWD/0.0,.38268,.70711,.92388,1.0,.92388,.70711,.38268,0.0,
     1    -.38268,-.70711,-.92388,-1.0,-.92388,-.70711,-.38268/
C
C     SINWD(IWNDIR)=SIN((PI*FLOAT(IWNDIR-1))/8)
C
      DATA PI4,PI8/.7853982,.3926991/
C
      DATA USCALE,GDSCAL/1.0,1000./
C
      DATA REGION/18*'    '/
C
      DATA INC/2*0/
C
C     DELTA  SCALE FACTOR FOR THE RECEPTOR GRID (KILOMETERS)
C     RBASE(1),RBASE(2)  RECEPTOR GRID BASE ORIGIN (KILOMETERS)
      DATA DELTA,RBASE/3*0./
C     NSORCE.............NUMBER OF SOURCES
      DATA NSORCE/0/
C      INCRX, INCRY                # OF COLUMNS AND ROWS OF RECEPTOR GRID
      DATA INCRX,INCRY/2*0/
C     TA.................AMBIENT TMPERATURE IN DEG-K
C     PA.................AMBIENT PRESSURE IN MILIBARS
```

NOT REPRODUCIBLE

```
      DATA TA/340./, PA/1000./                                          BLOC 500
C                                                                       BLOC 510
C     CORREL............LOOK-UP TABLE FOR 5% CONFIDENCE LEVEL           BLOC 520
C     FOR CORRELATION COEFFICIENTS                                      BLOC 530
C                                                                       BLOC 540
      DATA CORREL /        .997,     .950,     .878,     .811,     .754, BLOC 550
     1                     .707,     .666,     .632,     .602,     .576, BLOC 560
     2                     .553,     .532,     .514,     .497,     .482, BLOC 570
     3                     .469,     .456,     .444,     .433,     .423, BLOC 580
     4                     .413,     .404,     .396,     .388,     .381, BLOC 590
     5                     .374,     .367,     .361,     .355,     .349, BLOC 600
     6                     .344,     .339,     .335,     .330,     .325, BLOC 610
     7                     .321,     .319,     .312,     .308,     .304, BLOC 620
     8                     .301,     .298,     .294,     .291,     .288, BLOC 630
     9                     .285,     .282,     .279,     .276,     .273, BLOC 640
     .                     .271,     .268,     .266,     .264,     .262, BLOC 650
     .                     .259,     .257,     .255,     .252,     .250, BLOC 660
     .                     .248,     .246,     .245,     .243,     .241, BLOC 670
     .                     .239,     .237,     .236,     .234,     .232, BLOC 680
     .                     .231,     .229,     .228,     .226,     .225, BLOC 690
     .                     .223,     .222,     .220,     .219,     .217, BLOC 700
     .                     .216,     .215,     .213,     .212,     .211, BLOC 710
     .                     .210,     .209,     .207,     .206,     .205, BLOC 720
     .                     .204,     .203,     .202,     .201,     .200, BLOC 730
     .                     .199,     .198,     .197,     .196,     .195/ BLOC 740
C                                                                       BLOC 750
      DATA UU / .67056, 2.45872, 4.47040, 6.92912, 9.61136, 12.51712/   BLOC 760
C     A, B, C............COEFFICIENTS FOR SIG-Z                         BLOC 770
      DATA A/ .001, .048, .119, 2.610, 52.600, .187, .135/              BLOC 780
      DATA B/1.890, 1.110, .915, .450, .150, .755, .745/                BLOC 790
      DATA C/ 9.6, 2.00, 0.00, -25.5, -126.0, -1.4, -1.1/               BLOC 800
      END                                                               BLOC 810
```

SUBROUTINE CAMP

Purpose:

This subroutine is a subdriver to compute the concentration values at specified monitoring stations by calling PØLUT1. It then calls REG to calculate the Y-intercept and the slope of the regression equation between the computed and the observed concentration values at those stations.

Input:

NSØ2 ------------------------- number of monitoring stations for SØ2 (<100).

NPART ------------------------ number of monitoring stations for particulates (<100).

Output:

None (directly from this routine).

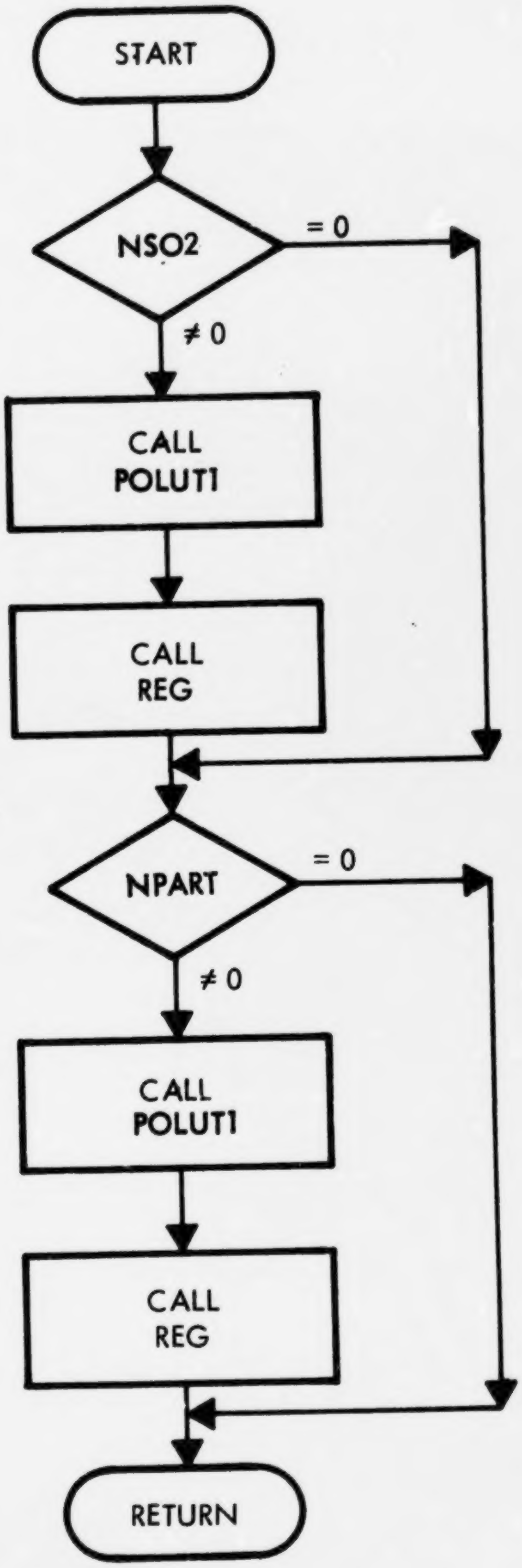
Procedure:

1. Test the number of stations for SØ2. If zero, move to the next pollutant.
2. Call PØLUT1 and compute the ground-level concentration at CAMP stations (up to 100).
3. Call REG and compute AC and BC, the Y-intercept and the slope, respectively.
4. Test the number of monitoring station for particulates. If zero, RETURN.
5. Call PØLUT1 to compute ground-level concentration.
6. Call REG to compute Y-intercept and slope.

Subroutine Called:

PØLUT1, REG

SUBROUTINE CAMP



```
      SUBROUTINE CAMP
C
C     SUBROUTINE CAMP IS ANOTHER SUBDRIVER TO COMPUTE THE REGRESSION
C     OUTPUT BY CALLING POLUT1 AND REG.  IT CONSIDERS THE SO2 CAMP
C     STATIONS AND PARTICULATE CAMP STATIONS SEPARATELY.
C
       COMMON /DOLP/ IPOLU1,IPOLU2,INC(2),JFL
      COMMON /RGSN/ AC(2),BC(2),CORREL(100)
      COMMON /RCPT/ RECEPT(2,237),CPCLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUT5(2,5),
     3              PT5(2,5)
      JFL = 0
      IF (NSO2.EQ.0) GO TO 11
      DO 10 IRECEP=1,NSO2
      CALL POLUT1(1)
   10 CONTINUE
      CALL REG(1)
   11 CONTINUE
      IF (NPART.EQ.0) GO TO 15
      DO 12 IRECEP=1,NPART
      CALL POLUT1(2)
   12 CONTINUE
      CALL REG(2)
   15 CONTINUE
      RETURN
      END
```

SUBROUTINE CØNVRT

Purpose:

1. To write the input with proper headings.
2. To translate receptor base and source locations with respect to ØRIGIN.
3. To preprocess source data.

Input:

SØRCE (6, 1000) -------------- X coordinate, Y coordinate, area of source, annual average SO_2 emission rate, annual average particulate emission rate, and physical stack height for up to 1000 sources.

RBASE(2) --------------------- receptor base location.

Output:

SØRCE (6,1000) --------------- same as the input array except for the emission rates, which are changed from tons/day to micrograms/sec.

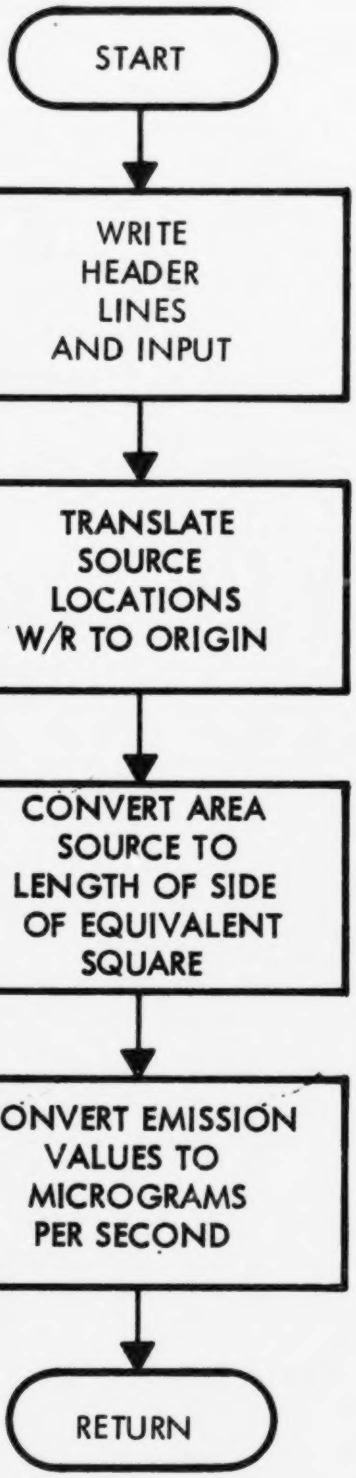
Procedure:

1. Write with appropriate headings.
2. Convert area sources to the length of a side of equivalent square.
3. Convert emission rate from tons per day to micrograms per second.

Subroutine Called:

None

SUBROUTINE CØNVRT


START
WRITE HEADER LINES AND INPUT
TRANSLATE SOURCE LOCATIONS W/R TO ORIGIN
CONVERT AREA SOURCE TO LENGTH OF SIDE OF EQUIVALENT SQUARE
CONVERT EMISSION VALUES TO MICROGRAMS PER SECOND
RETURN

```
      SUBROUTINE CONVRT
C
C     THE SUBROUTINE WRITES OUT THE INPUT, AND PREPROCESSES THE
C     SOURCE DATA
C
C     ********************SPECIFICATION STATEMENTS**********************
      LOGICAL SGTDMX
C                    FOR SIGZ GREATER THAN DMIX -- A LOGICAL VARIABLE
C
      COMMON /AIRQ/ AVRGTM(2,3),STANDV(2,12)
      COMMON /CONS/ PI4,PI8
      COMMON /CORD/ RBASE(2),DELTA,INCRX,INCRY,GDSCAL,QSCALE
      COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /LITL/ REGION(18)
      COMMON /LOGI/ SGTDMX,IPNCH
      COMMON /RCPT/ RECEPT(2,237),CPOLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUT5(2,5),
     3              PT5(2,5),NRECEP
      COMMON /REST/ A(7),B(7),C(7)
      COMMON /RGSN/ AC(2),BC(2),CORREL(100)
      COMMON /SELC/ ISEL12(2,12),NSEL12,ISEL5(2,5),NSEL5,XP(2,12)
      COMMON /SRCE/ SORCE(6,1000),PLUME(3,1000),CS(2,1000),BACKGR(2),
     1              IFLAG,NSORCE,TA,PA
      COMMON /WIND/ WNDFRQ(6,16,5),UU(6),SINWD(16),COSWD(16),DPTHMX
      REAL*4 WD(16)/ 'N  ','NNE','NE ','ENE','E  ','ESE','SE ','SSE',
     . 'S  ','SSW','SW ','WSW','W  ','WNW','NW ','NNW'/
C
      IF (IFLAG .EQ. 2) GO TO 4080
C
C     INITIALIZE LINE COUNTER
C
      LNCNT =9
 1000 WRITE(6,4040) REGION
 4040 FORMAT('1',T31,18A4//T6,'SOURCE DATA'/)
      WRITE(6,6000)
      WRITE(6,4045)
 4045 FORMAT(T5,'|',T14,'|',T40,'|',T61,'ANNUAL SOURCE',T80,'|', T88,
     . 'STACK DATA',T108,'|'     /
     . T5,'| SOURCE |',T20,'SOURCE LOCATION',T40,'| SOURCE AREA |',
     . T61,'EMISSION RATE',T80,'|',T108,'|'  /
     . T5,'| NUMBER |',T21,'(KILOMETERS)',T40,'|   SQUARE',T54,'|',
     . T62,'(TONS/DAY)',T80,'|   HT  DIAM   VEL    TEMP  |'  /
     . T5,'|',T14,'| HORIZONTAL |  VERTICAL  | KILOMETERS  |', T59,
     . 'SO2',T70,'PART',T80,'|  (M)  (M)  (M/SEC) (DEG.K)| ')
      WRITE (6,6000)
C
      DO 25 ISORCE=1,NSORCE
C     WRITE A UTM/STAKE DATA LINE
      WRITE(6,6015) ISORCE,(SORCE(I,ISORCE),I=1,6),
     1                PLUME(2,ISORCE),PLUME(1,ISORCE),PLUME(3,ISORCE)
C
      LNCNT=LNCNT+1
C     TEST FOR UNDERLINE
      IF(MOD(LNCNT ,3) .EQ. 0) WRITE (6,6000)
C
   25 CONTINUE
      IF(MOD(LNCNT,3).NE.0) WRITE(6,6000)
C
C
      WRITE(6,4000) REGION
   45 NRECP = INCRX * INCRY
      WRITE (6,4075) NRECP
 4075 FORMAT('0',T16,'RECEPTOR DATA' //
     . T16,'LOCATIONS TO BE USED AS RECEPTORS IN ADDITION TO THE ',I3,
     . ' RECTANGULAR GRID LOCATIONS' //
     . T18,'RECEPTOR',T32,'X-COORDINATE',T50,'Y-COORDINATE'  /
     . T19,'NUMBER',T32,'(KILOMETERS)',T50,'(KILOMETERS)'    /
     . '+',T18,'________',T32,'____________',T50,'____________' // )
      DO 4080 I=1,IADD
      NRECP = NRECP + 1
      WRITE (6,4085) NRECP,XRECEP(1,I), XRECEP(2,I)
 4085 FORMAT(T21,I3,T33,F7.1,T52,F7.1/)
 4080 CONTINUE
      NN = 0
      DO 4190 L = 1, 5
      WRITE(6,4091) REGION
 4091 FORMAT('1',T49,18A4//)
      WRITE(6,4095)
 4095 FORMAT(T44,'METEOROLOGICAL INPUT DATA FOR THE ANNUAL SEASON'///)
      IF (NN .EQ. 1) GO TO 60
      WRITE (6,4090) TA,PA,DPTHMX
 4090 FORMAT(T31,'AMBIENT TEMPERATURE = ',F5.0,' DEG-K;',
     1        T66,'AMBIENT PRESSURE = ',F5.0,' MILLIBARS'/
     2        T31,'MIXING DEPTH = ',F5.0,' METERS'//)
      NN = 1
   60 WRITE(6,5100) L
 5100 FORMAT(T31,'STABILITY CLASS ',I2/ T70,'WINDSPEED CLASS'// T33,
     1   'WIND DIRECTION',T55,'1',T64,'2',T73,'3',T82,'4',T91,'5',
     2   T100,'6'/)
      WRITE(6,5105) (WD(K),(WNDFRQ(J,K,L),J=1,6),K=1,16)
 5105 FORMAT(T38,A3,T53,F6.4,3X,F6.4,3X,F6.4,3X,F6.4,3X,F6.4,3X,F6.4/)
 4190 CONTINUE
      IF (IFLAG .EQ. 2) GO TO 2002
C
C   LIST STANDARD GEOMETRIC DEVIATION DATA FOR STATISTICAL OUTPUT
C
      IF (NSEL12 .EQ. 0) GO TO 2002
C
      WRITE (6,4000) REGION
```

```
C
      WRITE (6,4001)
 4001 FORMAT(T16,'RECEPTOR INFORMATION FOR STATISTICAL OUTPUT'//)
C
      WRITE (6,4002)
 4002 FORMAT(T30,'SO2',T70,'PARTICULATES'/'+'T16,7('____'),'___',T60,
     .         7('____'),'___')
      WRITE (6,4003)
 4003 FORMAT(T16,'SELECTED',T29,'STANDARD GEOMETRIC',T60,'SELECTED',
     1  T73,'STANDARD GEOMETRIC'/T16,'RECEPTOR',T29,'DEVIATION (24 HR.',
     2  T60,'RECEPTOR',T73,'DEVIATION (24 HR.'/T18,'NO.',
     3  T29,'AVERAGING TIME)',T62,'NO.',T73,'AVERAGING TIME)'//)
C
      WRITE (6,4004) ((ISEL12(I,J),STANDV(I,J),I=IPOLU1,IPOLU2),J=1,12)
 4004 FORMAT('0',12(T18,I3,T37,F4.2,T62,I3,T81,F4.2//))
C
C     PRE-PROCESS SOURCE-DATA
C
 2002 DO   80 ISORCE=1,NSORCE
C     CONVERT AREA TO SIDE LENGTH OF EQUIVALENT SQUARE.
      SORCE (3,ISORCE)=1000.*SQRT(SORCE (3,ISORCE))
C
C     MULTIPLY POLLUTANT TERMS
      DO 80 IPOLUT=IPOLU1,IPOLU2
   80 SORCE(IPOLUT+3,ISORCE)=SORCE(IPOLUT+3,ISORCE)*10.5*1.0E+06
C
C
 8000 CONTINUE
      RETURN
 6015 FORMAT(T5,'|',2X,I3,3X,'|',2X,F7.1,3X,'|',2X,F7.1,3X,'|',4X,F6.2,
     1  3X,'|',2X,  F7.3,5X,  F7.3,4X,'|',1X,F5.1,   F5.1,2X,F5.1,2X,
     2F6.0,1X,'|')
 6000 FORMAT(1H+,T5,'__________________________________________________
     1_______________________________________________')
 4000 FORMAT('1',T16,18A4//)
      END
```

SUBROUTINE DIFMØD

Purpose:

1. To construct a receptor grid of INCRX by INCRY
2. To add up to 12 receptors selected by the user.

This subroutine also functions as a subdriver, calling four other routines to compute the calibration coefficients, receptor concentration values, and the five maximum concentration values.

Input:

INCRX	number of columns of receptor grid
INCRY	number of rows of receptor grid
DELTA	distance between two consecutive grid rows or columns
RBASE (2)	origin of receptor grid

Output:

RECEPT (2, 237)	an INCRX by INCRY grid. Usually 15 x 15 or 225 receptor points, plus 12 selected receptors, is the outcome.

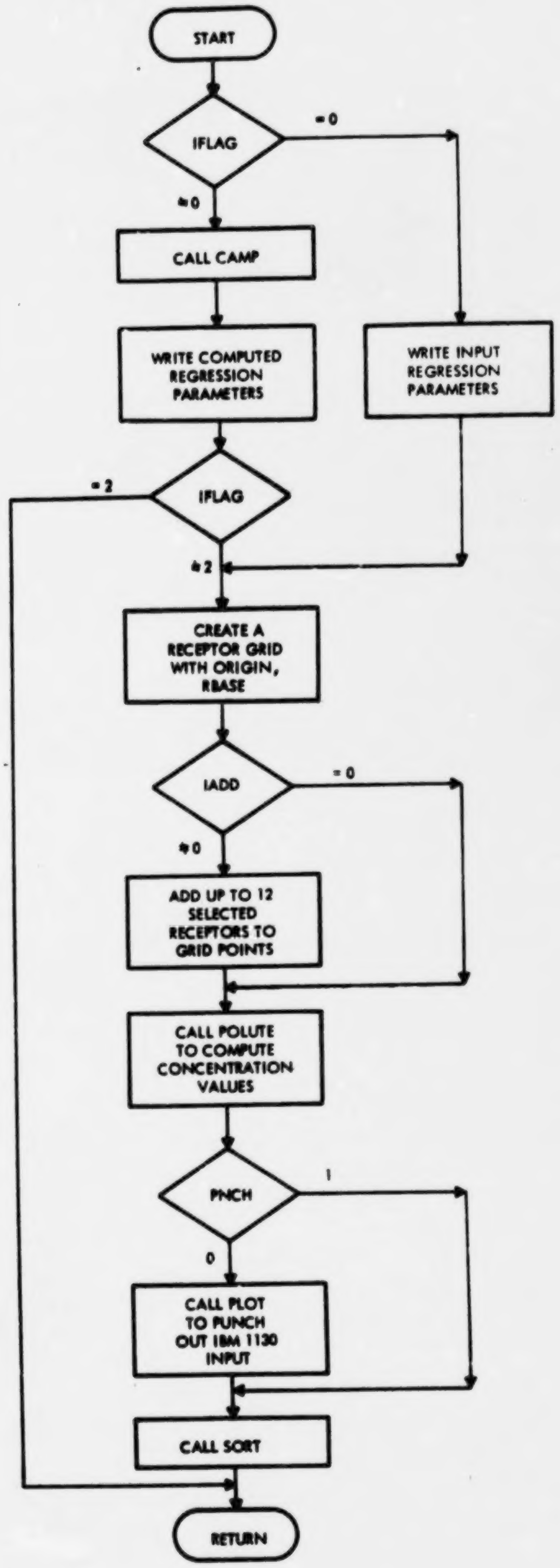
Procedure:

1. Call CAMP if regression coefficients are to be computed.
2. Compute grid mesh point locations with RBASE (1) and RBASE (2) being X and Y coordinates of the grid origin.
3. Add up to 12 receptor points (those selected by the user) to the array, RECEPT.
4. Call PØLUT to compute receptor concentration values at RECEPT.
5. Call PLØT to obtain a deck of concentration values for IBM 1130, if desired. This deck does not include the selected values.
6. Call SØRT to arrange the concentration values in descending order.

Subroutine Called:

CAMP, PØLUT, PLØT, SØRT

SUBROUTINE DIFMØD


START
IFLAG
= 0
≠ 0
CALL CAMP
WRITE COMPUTED REGRESSION PARAMETERS
WRITE INPUT REGRESSION PARAMETERS
IFLAG
= 2
≠ 2
CREATE A RECEPTOR GRID WITH ORIGIN, RBASE
IADD
= 0
≠ 0
ADD UP TO 12 SELECTED RECEPTORS TO GRID POINTS
CALL POLUTE TO COMPUTE CONCENTRATION VALUES
PNCH
1
0
CALL PLOT TO PUNCH OUT IBM 1130 INPUT
CALL SORT
RETURN

```
      SUBROUTINE DIFMOD
C
C     SUBROUTINE DIFMOD IS A SUBDRIVER WHICH CALLS CAMP IF CORRELATION
C     DATA IS DESIRED, POLUT TO COMPUTE G.L.C., PLOT TO PUNCH OUT
C     THE 1130 INPUT DECK IF DESIRED, AND SORT TO ARRANGE THE G.L.C.
C     IN DESCENDING ORDER.  IT ALSO CREATES THE RECEPTOR GRID.
C
      LOGICAL SGTDMX
C                    FOR SIG/ GREATER THAN DMIX -- A LOGICAL VARIABLE
      COMMON /AIRQ/ AVRGTM(2,3),STANDV(2,12)
      COMMON /CONS/ PI4,PI8
      COMMON /CORD/ RBASE(2),DELTA,INCRX,INCRY,GDSCAL,QSCALE
       COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /FIXX/ LINCT
      COMMON /LITL/ REGION(18)
      COMMON /LOGI/ SGTDMX,IPUNCH
      COMMON /RCPT/ RECEPT(2,237),CPCLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUT5(2,5),
     3              PT5(2,5),NRECEP
      COMMON /REST/ A(7),B(7),C(7)
      COMMON /RGSN/ AC(2),BC(2),CORREL(100)
      COMMON /SELC/ ISEL12(2,12),NSEL12,ISEL5(2,5),NSEL5,XP(2,12)
      COMMON /SRCE/ SORCE(6,1000),PLUME(3,1000),CS(2,1000),BACKGR(2),
     1              IFLAG,NSORCE,TA,PA
      COMMON /WIND/ WNDFRQ(6,16,5),UU(6),SINWD(16),COSWD(16),DPTHMX
C
      REAL*8 SOPAR(4)
C
      DATA SOPAR/'SO2                ','PARTICULATES    '/
C
      IF (IFLAG .NE. 0) GO TO 6
C
C     LIST REGRESSION PARAMETER INPUTS
C
      WRITE (6,4000) REGION
C
      WRITE (6,7060)
C
      DO 5 K= IPOLU1,IPOLU2
      KK = K*2 - 1
      JJ = KK + 1
      WRITE (6,7065) (SOPAR(I),I=KK,JJ), AC(K), BC(K)
    5 CONTINUE
      GO TO 10
C
    6 CALL CAMP
      IF (NSO2 .EQ. 0) GO TO 7505
      LNCT = 17
      DO 7500 I=1,NSO2
      IF(I.EQ.1.OR.LNCT.GT.60) GO TO 6995
      GO TO 7034
 6995 IF(MOD(I,3).NE.0.AND.I.GT.1) WRITE(6,7000)
                LNCT = 17
                WRITE(6,4000) REGION
      WRITE(6,7000)
      WRITE(6,7005)
      WRITE(6,7010)
      WRITE(6,7000)
      WRITE(6,7015)
      WRITE(6,7020)
      WRITE(6,7025)
      WRITE(6,7000)
      WRITE(6,7030)
 7034 WRITE(6,7035)     I,SO2LOC(1,I),SO2LOC(2,I),SO2OBS(I),CPOLUT(1,I)
      LNCT = LNCT + 1
      IF(MOD( I, 3). EQ.0) WRITE(6,7000)
 7500 CONTINUE
      IF(MOD(NSO2,3).NE.0) WRITE(6,7000)
 7505 IF (NPART .EQ. 0) GO TO 10
      LNCT = 17
      DO 7550 I=1,NPART
      IF(I.EQ.1.OR.LNCT.GT.60) GO TO 6990
      GO TO 7050
 6990 IF(MOD(I,3).NE.0.AND.I.GT.1) WRITE(6,7000)
                LNCT = 17
                WRITE(6,4000) REGION
      WRITE(6,7000)
      WRITE(6,7005)
      WRITE(6,7010)
      WRITE(6,7000)
      WRITE(6,7015)
      WRITE(6,7045)
      WRITE(6,7025)
      WRITE(6,7000)
      WRITE(6,7030)
 7050 WRITE(6,7035)  I,PARLOC(1,I),PARLOC(2,I),PAROBS(I),CPOLUT(2,I)
      LNCT = LNCT + 1
      IF(MOD(I,3).EQ.0) WRITE(6,7000)
 7550 CONTINUE
      IF(MOD(NPART,3).NE.0) WRITE(6,7000)
      IF (IFLAG .EQ. 2) GO TO 9960
   10 IRECEP=0
C
C     CREATE A RECEPTOR GRID WITH ORIGIN AT RBASE
      X=RBASE(1)
      DO  75 LAT=1,INCRX
      Y=RBASE(2)
      DO  70 LON=1,INCRY
      IRECEP=IRECEP+1
      RECEPT(1,IRECEP)=X
      RECEPT(2,IRECEP)=Y
   70 Y=Y+DELTA
   75 X=X+DELTA
C
C     RESET NRECEP
      NRECEP=INCRX*INCRY
      IF (IADD .EQ. 0) GO TO 150
      DO 100 I = 1,IADD
      RECEPT(1,(NRECEP+I)) = XRECEP(1,I)
      RECEPT(2,(NRECEP+I)) = XRECEP(2,I)
  100 CONTINUE
      NRECEP=NRECEP + IADD
C
      LINCT = 100
  150 DO 9955 IRECEP=1,NRECEP
      CALL POLUT
 9955 CONTINUE
      IF(MOD(NRECEP,3).NE.0) WRITE(6,6000)
      IF (IPUNCH .EQ. 1) GO TO 9956
      NRECEP = NRECEP - IADD
      CALL PLOT
      NRECEP = NRECEP + IADD
 9956 CONTINUE
      CALL SORT
 9960 CONTINUE
      RETURN
 4000 FORMAT('1',T42,18A4//)
 6000 FORMAT(1H+,T10,'____________________________________________________________
     *____________________')
 7000 FORMAT('+',T30,'_____________________________________________________
     1________________________')
 7005 FORMAT(T30,'|',T102,'|')
 7010 FORMAT(T30,'|',T58,'CORRELATION DATA',T102,'|')
 7015 FORMAT(T30,'|',T45,'|',T74,'|',T102,'|')
 7020 FORMAT(T30,'|',T36,'SO2',T45,'|',T51,'RECEPTOR LOCATION',T74,'|',
     1   T81,'SO2 CONCENTRATION',T102,'|')
 7025 FORMAT(T30,'|  MONITORING  |',T54,'(KILOMETERS)',T74,'|',T78,
     1   '(MICROGRAMS/CU. METER)  |'/T30,'|',T34,'STATION',T45,'|',
     2   T48,'HORIZONTAL',T63,'VERTICAL',T74,'|',T78,'OBSERVED',T89,
     3   'CALCULATED',T102,'|')
 7030 FORMAT (T30,'|',T45,'|',T59,'|',T74,'|',T87,'|',T102,'|')
 7035 FORMAT (T30,'|',T36,I3,T45,'|',T50,F6.1,T59,'|',T64,F6.1,T74,
     1     '|',T79,F5.0,T87,'|',T92,F5.0,T102,'|')
 7040 FORMAT ('1')
 7042 FORMAT(//)
 7045 FORMAT (T30,'|  PARTICULATE',T45,'|',T51,'RECEPTOR LOCATION',T74,
     1   '|',T76,'PARTICULATE CONCENTRATION',T102,'|')
 7060 FORMAT(T10,'INPUT REGRESSION PARAMETERS ARE:'//T15,'POLLUTANT',
     1        T35,'Y-INTERCEPT',T58,'SLOPE'/'+',T15,'___________',T29,
     2        6('____'),T56,2('____')//)
 7065 FORMAT(T14,2A8,T37,F7.1,T57,F7.4//)
      END
```

MAIN

Purpose:

1. To reset input variables for multiple runs
2. To read NAMELIST input
3. To write out NAMELIST input
4. To test input and write out diagnostic messages if necessary
5. To call various modules

Input:

NAMELIST, 'INDATA'

Output:

NAMELIST, 'INDATA'

Diagnostic messages in case of incorrect input

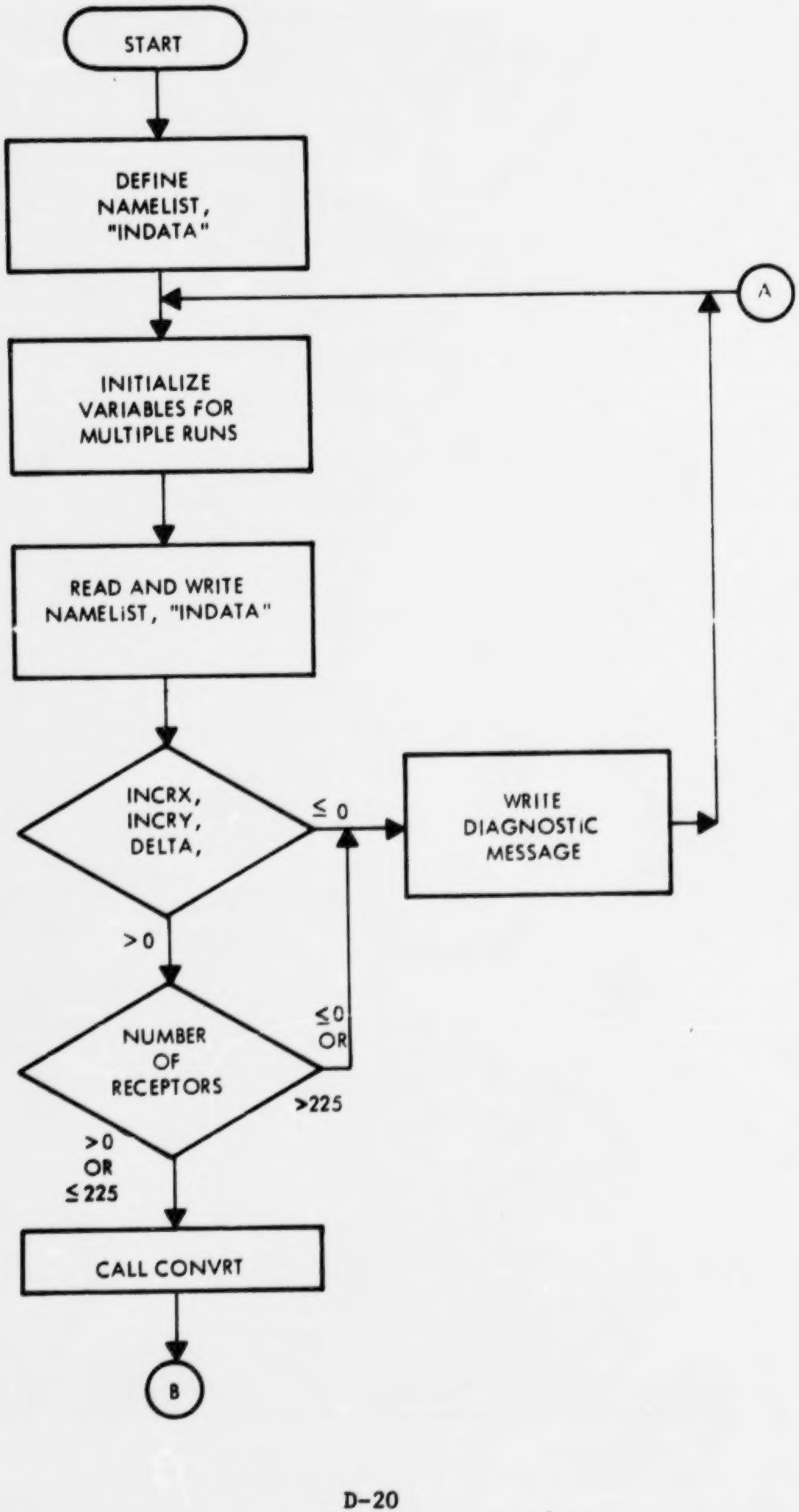
Procedure:

1. Initialize arrays and variables.
2. Read and write 'INDATA'.
3. Test number of pollutants. If less than zero or greater than 2, write a diagnostic message, and read in the next set of data.
4. Test number of columns and rows and the distance between two consecutive columns or rows. If not within acceptable bounds, write a diagnostic message and read in the next set of data.
5. Test number of receptor points. If less than one or greater than 237, write a diagnostic message and read in the next set of data.

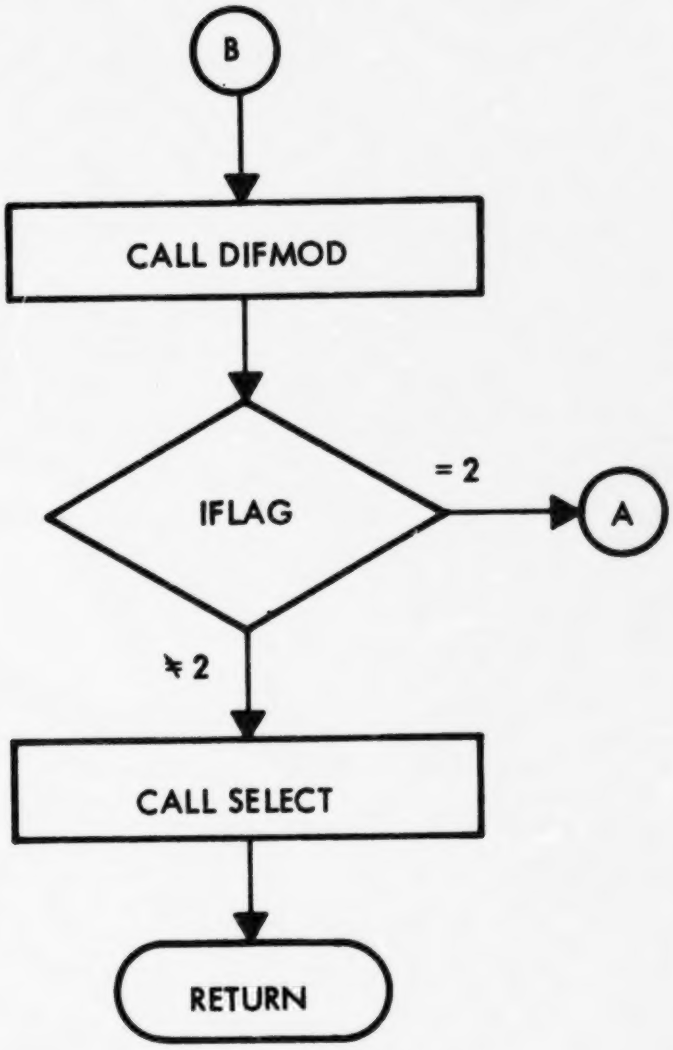
Subroutines Called:

CØNVRT, DIFMØD, SELECT

MAIN


START
DEFINE NAMELIST, "INDATA"
A
INITIALIZE VARIABLES FOR MULTIPLE RUNS
READ AND WRITE NAMELIST, "INDATA"
INCRX, INCRY, DELTA,
≤ 0
WRITE DIAGNOSTIC MESSAGE
> 0
NUMBER OF RECEPTORS
≤ 0 OR > 225
> 0 OR ≤ 225
CALL CONVRT
B

MAIN (Continued)



```
      LOGICAL SGTDMX
C                   FOR SIGZ GREATER THAN DMIX -- A LOGICAL VARIABLE
      COMMON /AIRQ/ AVRGTM(2,3),STANDV(2,12)
      COMMON /CONS/ PI4,PI8
      COMMON /CORD/ RBASE(2),DELTA,INCRX,INCRY,GDSCAL,QSCALE
       COMMON /DOLP/  IPOLU1,IPOLU2,INC(2),JFL
      COMMON /FIXX/ LINCT
      COMMON /LITL/ REGION(18)
      COMMON /LOGI/ SGTDMX,IPUNCH
      COMMON /RCPT/ RECEPT(2,237),CPOLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUT5(2,5),
     3              PT5(2,5),NRECEP
      COMMON /REST/ A(7),B(7),C(7)
      COMMON /RGSN/ AC(2),BC(2),CORREL(100)
      COMMON /SELC/ ISEL12(2,12),NSEL12,ISEL5(2,5),NSEL5,XP(2,12)
      COMMON /SRCE/ SORCE(6,1000),PLUME(3,1000),CS(2,1000),BACKGR(2),
     1              IFLAG,NSORCE,TA,PA
      COMMON /WIND/ WNDFRQ(6,16,5),UU(6),SINWD(16),COSWD(16),DPTHMX
C
      DIMENSION                                SO2CAL(2),PARCAL(2),
     1  SO2OB(3,100),PAROB(3,100),ICONS(5),ICONP(5),ISTATS(12),
     2  ISTATP(12),SGDS(12),SGDP(12),SO2AVG(3),PARAVG(3)
C
C     NAMELIST INDATA LIST OF DATA TO BE ENTERED************************
C
      NAMELIST/INDATA/REGION,NSORCE,IFLAG,IPUNCH,NSEL5,NSEL12,NPOLUT,
     1                NSO2,NPART,ICONS,ICONP,ISTATS,ISTATP,INCRX,INCRY.
     2                DELTA,DPTHMX,IADD,XRECEP,BACKGR,TA,PA,SORCE,PLUME,
     3                SO2CAL,PARCAL,SC2OB,PAROB,SGDS,SGDP,SO2AVG,PARAVG,
     4                WNDFRQ,RBASE
C
    1 CONTINUE
      DO 5 I=1,12
           ISTATS(I) = 0
           ISTATP(I) = 0
           SGDS(I) = 0
           SGDP(I) = 0
    5 CONTINUE
      DO 10 J = 1,5
           ICONS(J) = 0
           ICONP(J) = 0
   10 CONTINUE
      DO 15 L=1,1000
      DO 13 M= 1,6
           SORCE(M,L) = 0.0
   13 CONTINUE
      DO 14 N= 1,3
           PLUME(N,L) = 0.0
   14 CONTINUE
```

```
      DO 15 LL= 1,2
C     CS(IPOLUT,ISORCE)                   SOURCE CONTRIBUTIONS TO RECEPTOR
          CS(LL,L) = 0.0
   15 CONTINUE
      DO 20 LL=1,2
      DO 20 L=1,237
C     CPOLUT(IPOLUT,IRECEP)               CONCENTRATION VALUES
      CPOLUT(LL,L) = 0.0
C     RECEPT  (1,IRECEP)=HORIZONTAL COMPONENT OF RECEPTOR
C     RECEPT  (2,IRECEP)=  VERTICAL COMPONENT OF RECEPTOR
      RECEPT(LL,L) = 0.0
   20 CONTINUE
C
      DO 25 L= 1,3
      DO 25 LL= 1,100
          SO2OB(L,LL) = 0.0
          PAROB(L,LL) = 0.0
   25 CONTINUE
      DO 30 I= 1,2
          SO2CAL(I) = I - 1
          PARCAL(I) = I - 1
   30 CONTINUE
C
C     IADD...............NUMBER OF ADDITIONAL RECEPTORS
      IADD = 0
      IPUNCH = 0
      IPOLU1 = 1
      IPOLU2 = 2
C
C     IFLAG..............FLAG FOR REGRESSION OUTPUT
      IFLAG = 0
C     NSO2...............NUMBER OF SO2 CAMP STATIONS
      NSO2 = 0
C     NPART..............NUMBER OF PARTICULATE CAMP STATIONS
      NPART = 0
      NSEL5 = 0
      NSEL12 =0
      NPOLUT = 0
C
C     READ THE NAMELIST 'INDATA'
C
      READ (5,INDATA,END=35)
      WRITE (6,INDATA)
      WRITE (6,6036)
C
      IF(NPOLUT .EQ. 1) IPOLU2 = 1
      IF(NPOLUT .EQ. 2) IPOLU1 = 2
C
      DO 40 I= 1,5
C
```

```
          ISEL5(1,I)= ICONS(I)
          ISEL5(2,I)= ICONP(I)
   40 CONTINUE
C
      DO 45 I= 1,12
          ISEL12(1,I)  = ISTATS(I)
          ISEL12(2,I)  = ISTATP(I)
          STANDV(1,I)  = SGDS(I)
          STANDV(2,I)  = SGOP(I)
   45 CONTINUE
C
C     AC(IPOLUT), BC(IPOLUT),             Y-INTERCEPT, SLOPE
          AC(1) = SO2CAL(1)
          AC(2) = PARCAL(1)
          BC(1) = SO2CAL(2)
          BC(2) = PARCAL(2)
      DO 55 II= 1,100
      DO 50 I= 1,2
          SO2LOC(I,II) = SO2OB(I,II)
          PARLOC(I,II) = PAROB(I,II)
   50 CONTINUE
          SO2OBS(II) = SO2OB(3,II)
          PAROBS(II) = PAROB(3,II)
   55 CONTINUE
      DO 60 I= 1,3
          AVRGTM(1,I) = SO2AVG(I,
          AVRGTM(2,I) = PARAVG(I)
   60 CONTINUE
C
C     TEST INCRX, INCRY, AND DELTA -- IF ANY .EQ. ZERO, READ NEXT CASE
      IF((FLOAT(INCRX-1)*FLOAT(INCRY-1)*DELTA) .LE. 0.0) GO TO 33
C     TEST NUMBER OF GRID POINTS
      NRECP=INCRX*INCRY
C
 2000 IF(NRECP .LE. 0 .OR. NRECP .GT. 237) GO TO 34
C
      CALL CONVRT
      CALL DIFMOD
      IF (IFLAG .EQ. 2) GO TO 1
      CALL SELECT
      GO TO 1
   33 WRITE (6,6033) INCRX, INCRY, DELTA
      GO TO 1
   34 WRITE (6,6034) INCRX,INCRY
      GO TO 1
   35 WRITE (6,6035)
 1001 CONTINUE
      STOP
 6033 FORMAT (1H0,' *** EITHER INCRX (',I5,'), INCRY (',I5,'), OR DELTA
     1(',F7.2,') IS ZERO.  READ NEXT DATA SET. * * ')
 6034 FORMAT (1H0,' * * TOO MANY RECEPTORS (',I3,'*',I3,'.GT.',I4,')',/)
 6035 FORMAT (1H1,' END OF FILE ENCOUNTERED -- TERMINATE RUN.')
 6036 FORMAT('1')
      END
```

SUBROUTINE ØRDER

Purpose:

To sort a one-dimensional array and corresponding indices in descending order.

Input:*

N ------------------------ number of elements in the array

A ------------------------ one-dimensional array, dimensioned as A(N)

NRECEP -------------------- array of indices corresponding to the elements in A; dimensioned as INDEX(N)

* Input through calling sequence.

Output:

A ------------------------ one-dimensional ordered array

NRECEP -------------------- indices of A, ordered according to the magnitudes of elements in A

Procedure:

1. Compare A(1) with A(2), A(3),....., A(N). If A(1) is less than any of the remaining numbers, replace A(1) with that number. Repeat this process until the largest number in the array is found and stored into A(1) position.
2. Compare A(2) with A(3), A(4),....., A(N); to find the second largest number.

   A(3) with A(4),..........., A(N); .

   . .

   . .

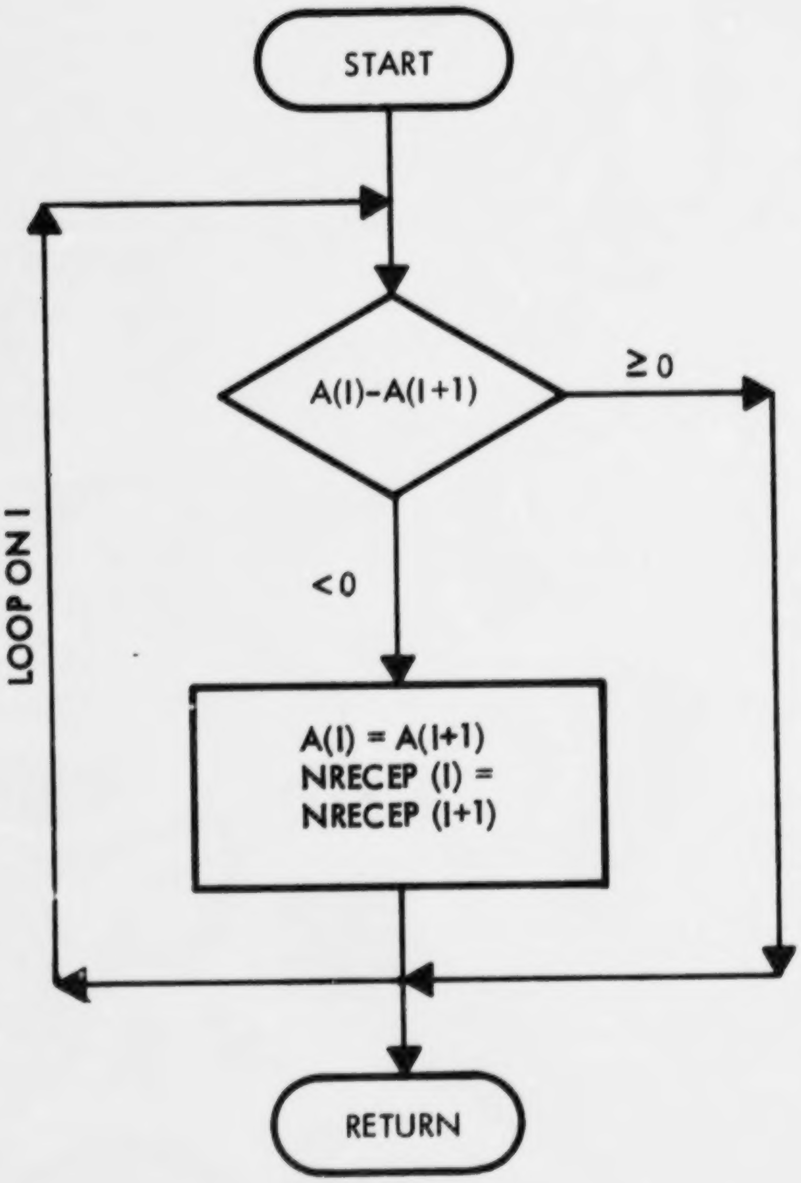
   . .

   A(N-1) with A(N);
3. Order the indices according to the values in array A.

Subroutine Called:

None

SUBROUTINE ØRDER



```
      SUBROUTINE ORDER(N,A,NRECEP)
C
C     THIS ROUTINE SORTS N VALUES AND THEIR INDECIES IN DESCENDING
C     ORDER.
C
      DIMENSION A(N), NRECEP(N)
C
      M=N-1
      DO 100 I=1,M
      K=I+1
      DO 100 J=K,N
      IF (A(I)-A(J)) 10,100,100
C
C     ORDER THE CONCENTRATION VALUES
   10 TEMP=A(I)
      A(I)=A(J)
      A(J)=TEMP
C     ORDER THE RECEPTOR NUMBERS
      TEMP=NRECEP(I)
      NRECEP(I)=NRECEP(J)
      NRECEP(J)=TEMP
  100 CONTINUE
      RETURN
      END
```

SUBROUTINE PLØT

Purpose:

This subroutine punches out the calibrated ground-level concentration deck for the IBM 1130 to produce iso-pollutant-concentration contour plots.

Input:

CPØLUT (2, 237) ----------------- calibrated ground-level concentrations

NRECEP -------------------------- number of receptors

Output:

CPØLUT (2, 237) ----------------- ground-level concentration in punched deck

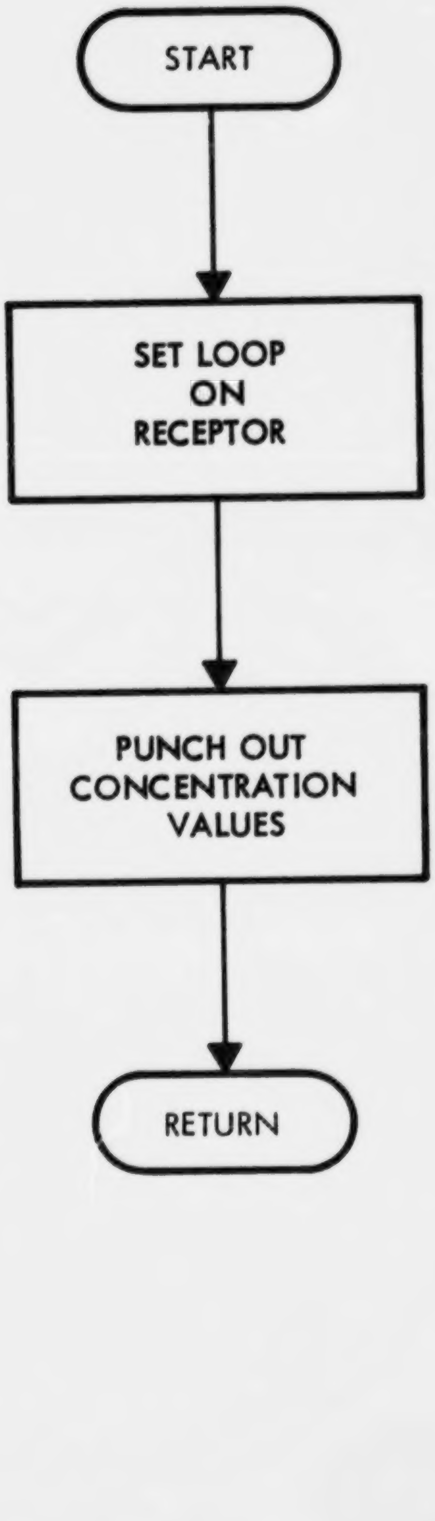
Procedure:

For each receptor punch one card containing nine concentration values, three pollutants, and three seasons.

Subroutine Called:

None

SUBROUTINE PLØT



```
      SUBROUTINE PLOT
C
C     SUBROUTINE PLOT PUNCHES OUT THE INPUT DECK FOR THE IBM 1130
C     FOR PLOTTING ISO-POLLUTANT CONTOURS.
C
       COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /RCPT/ RECEPT(2,237),CPOLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUT5(2,5),
     3              PT5(2,5),NRECEP
C
C     PUNCH A RECEPTOR DATA CARD
      DO 2050 IRECEP=1,NRECEP
      WRITE (7,72050) (RECEPT(L,IRECEP),L=1,2),(CPOLUT(IPOLUT,IRECEP),
     1               IPOLUT=IPOLU1,IPOLU2)
72050 FORMAT (2P2F8.0,1X,2(2PF9.0))
 2050 CONTINUE
      WRITE (7,72055)
72055 FORMAT ('¬¬')
C
C     THE REMAINING CARDS FOR THE 1130 MUST BE PUNCHED BY HAND.
C     IF THE RANGE OF Z WERE TOO
C     GREAT, THE NUMBER OF CONTROL CARDS MAY BE INCREASED BY AN EVEN NUM
C     FOR EXAMPLE IF THE RANGE WERE FROM 0 TO 5000, THE ENTIRE GRAPH MAY
C     PLOTTED AS A COMBINATION OF TWO SUPERIMPOSED GRAPHS, THE OUTER GRA
C     HAVING THE Z-VALUES FROM 0 TO 100, THE INNER GRAPH HAVING THE Z-VA
C     FROM 100 TO 5000, THUS FOUR CONTROL CARDS ARE NEEDED TO ACCOMPLISH
C     IF ANNOTATION IS NEEDED USE XEC MAPAT.
C****************************1130 DATA HAS BEEN PUNCHED*****************
      RETURN
      END
```

SUBROUTINE PØLUT

Purpose:

To compute ground-level concentrations

Input:

RBASE(2)	receptor base location
IPØLU1, IPØLU2	lower and upper bounds of DØ loop on pollutants
RECEPT (2, 237)	receptor locations
A(7), B(7), C(7)	σ_z constants
AC(2)	y-intercepts
BC(2)	slopes
NSØRCE	number of sources
BACKGR(2)	background concentrations
PA	ambient pressure
TA	ambient temperature
DPTHMX	mixing depth
WNDFRQ(6, 16, 5)	relative frequency for each wind speed, wind direction, and wind stability combination
SINWD (16)	sine of wind direction
CØSWD (16)	cosine of wind direction
SØRCE (6, 1000)	X coordinate, Y coordinate, area of source, annual average SO_2 emission rate, annual average particulate emission rate, and physical stack height for up to 1000 sources
PLUME (3, 1000)	stack exit velocity, stack diameter and stack temperature
SGTDMX	flag to indicate the distance between the source and the receptor

Output:

CPØLUT (2, 237)	ground-level concentrations, calibrated and background concentrations added

SUBROUTINE PØLUT (Continued)

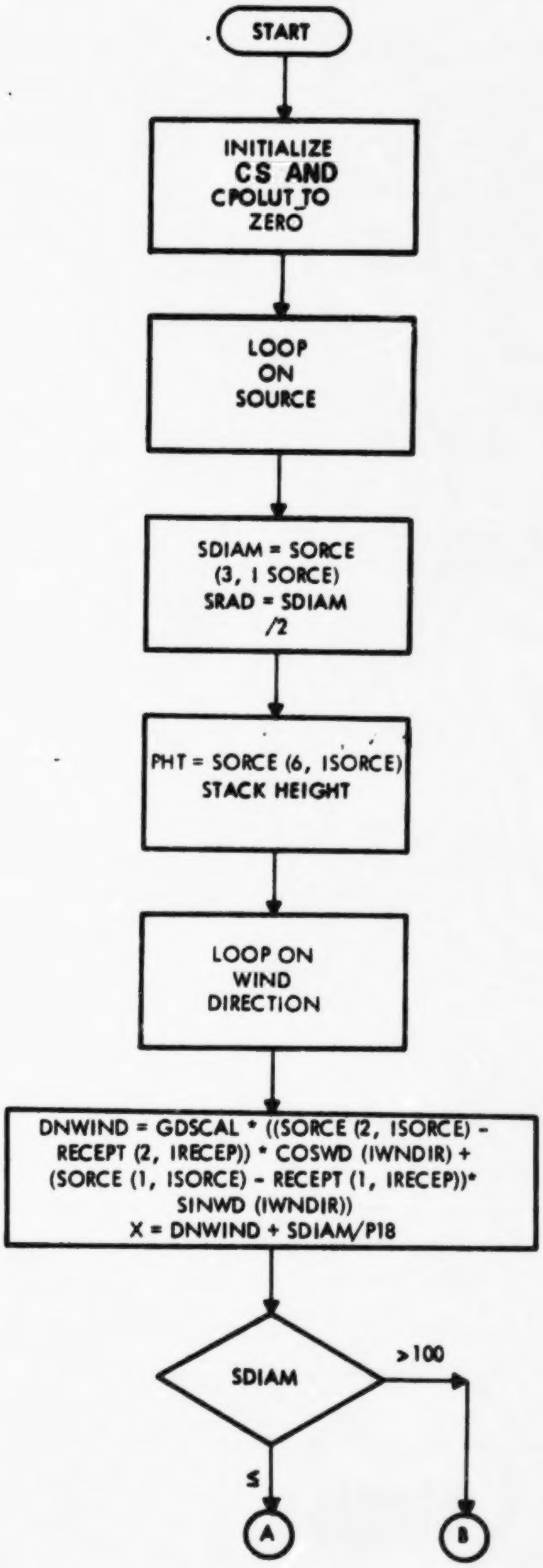
Procedure:

1. Initialize CPØLUT array to zero.
2. Determine the location of receptor with respect to the source location.
3. Compute the transfer coefficient, C3.
4. Multiply C3 and the source intensity; sum up the products for all sources. (This is a ground-level concentration.)
5. Calibrate ground-level concentration and add the background concentration
6. Write out receptor numbers, receptor locations, and ground-level concentrations.

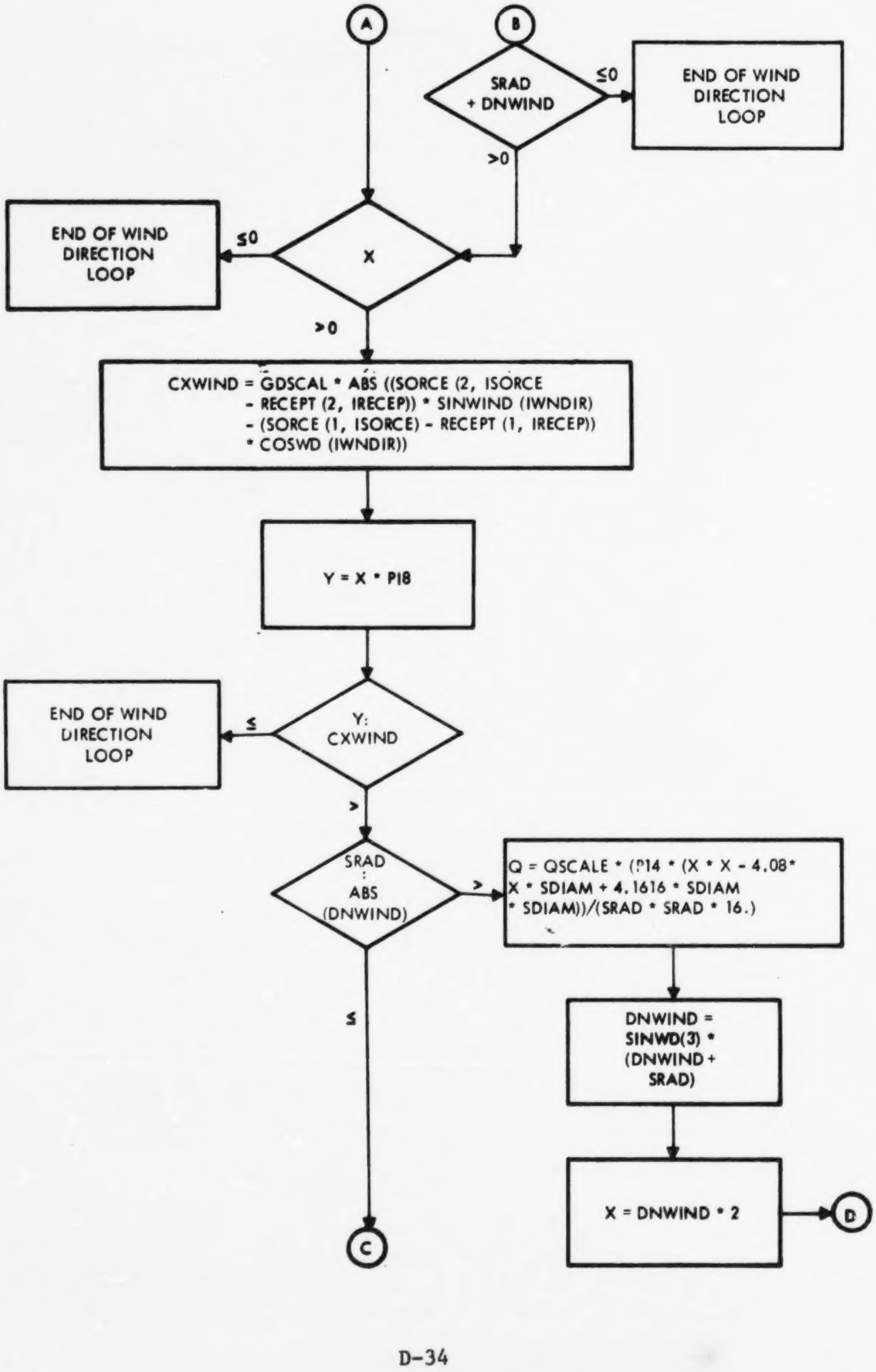
Subroutine Called:

None

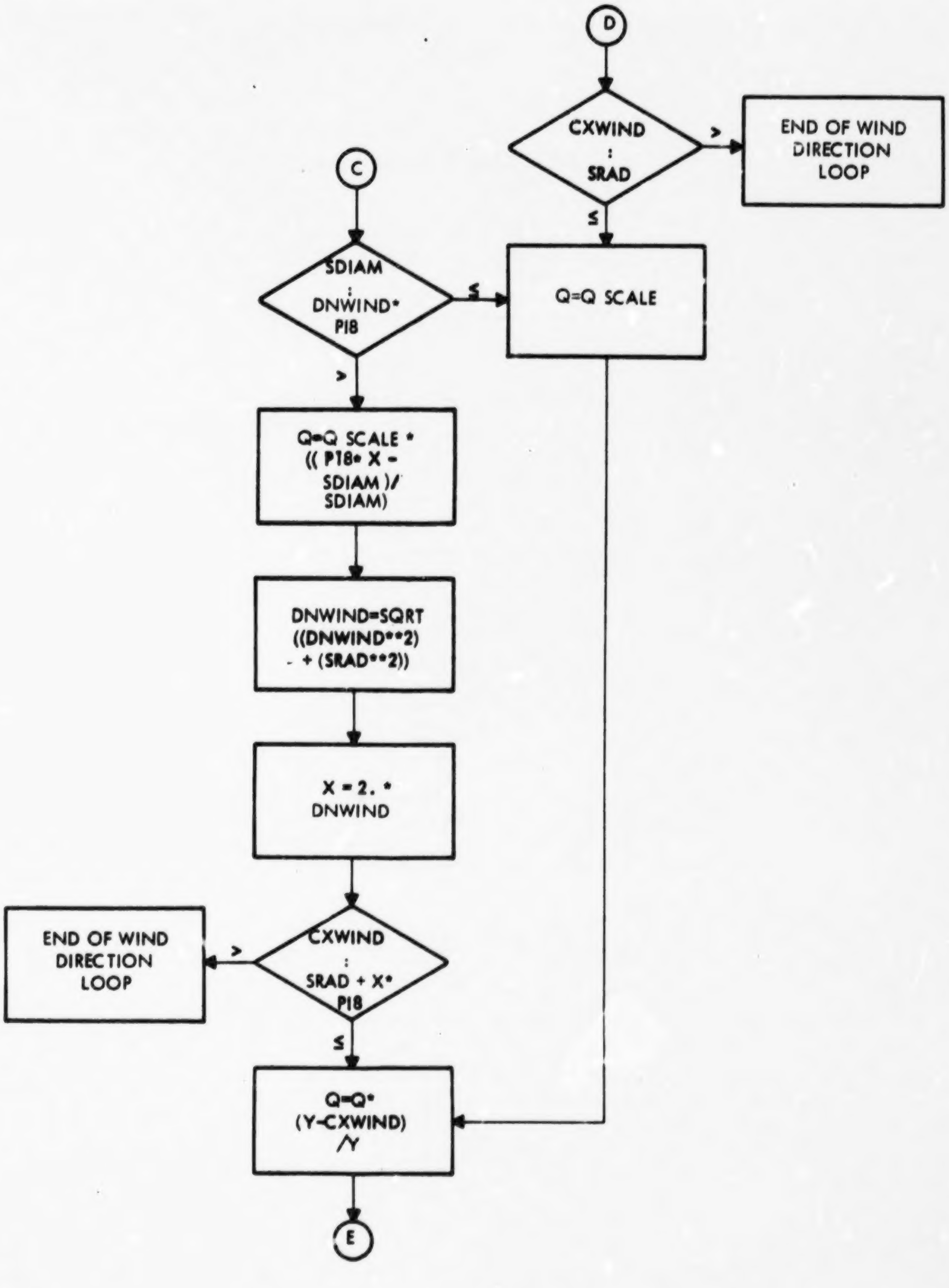
SUBROUTINE PØLUT


START
INITIALIZE CS AND CPOLUT TO ZERO
LOOP ON SOURCE
SDIAM = SORCE (3, I SORCE) SRAD = SDIAM /2
PHT = SORCE (6, ISORCE) STACK HEIGHT
LOOP ON WIND DIRECTION
DNWIND = GDSCAL * ((SORCE (2, ISORCE) - RECEPT (2, IRECEP)) * COSWD (IWNDIR) + (SORCE (1, ISORCE) - RECEPT (1, IRECEP))* SINWD (IWNDIR))
X = DNWIND + SDIAM/P18
SDIAM
>100
≤
A
B

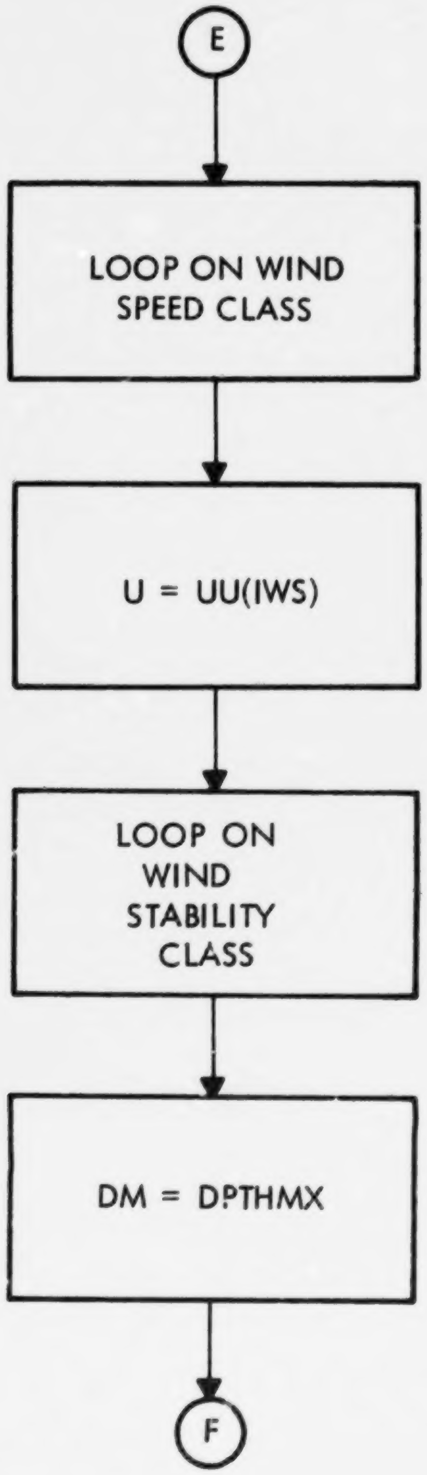
SUBROUTINE PØLUT (Continued)


A
B
SRAD
+ DNWIND
≤0
END OF WIND
DIRECTION
LOOP
>0
END OF WIND
DIRECTION
LOOP
≤0
X
>0
CXWIND = GDSCAL * ABS ((SORCE (2, ISORCE
- RECEPT (2, IRECEP)) * SINWIND (IWNDIR)
- (SORCE (1, ISORCE) - RECEPT (1, IRECEP))
* COSWD (IWNDIR))
Y = X * PI8
END OF WIND
DIRECTION
LOOP
≤
Y:
CXWIND
>
SRAD
:
ABS
(DNWIND)
>
Q = QSCALE * (PI4 * (X * X - 4.08*
X * SDIAM + 4.1616 * SDIAM
* SDIAM))/(SRAD * SRAD * 16.)
≤
DNWIND =
SINWD(3) *
(DNWIND +
SRAD)
X = DNWIND * 2
D
C

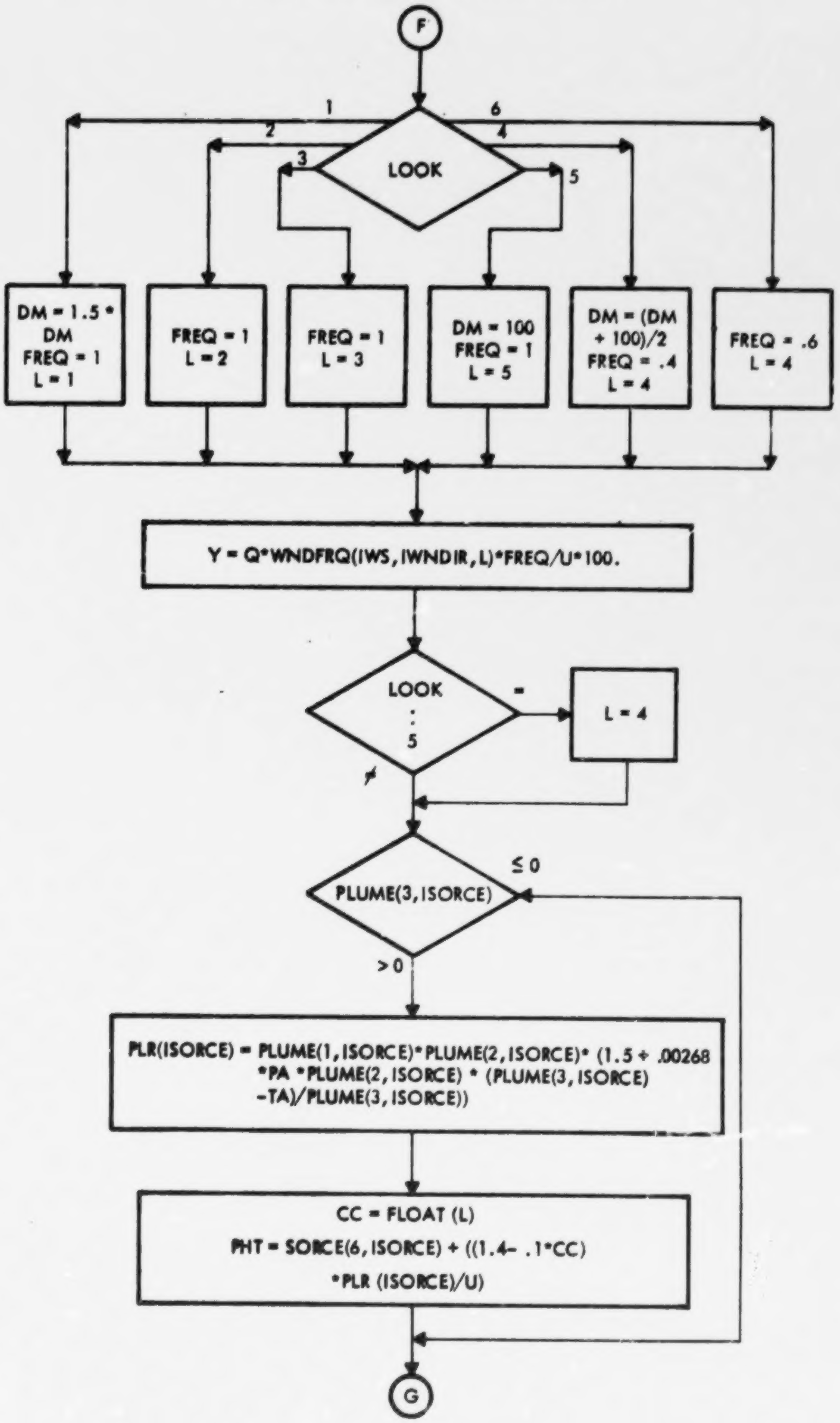
SUBROUTINE POLUT (Continued)


D
CXWIND : SRAD
>
END OF WIND DIRECTION LOOP
≤
C
SDIAM : DNWIND* PI8
≤
Q=Q SCALE
>
Q=Q SCALE * ((PI8* X - SDIAM)/ SDIAM)
DNWIND=SQRT ((DNWIND**2) + (SRAD**2))
X = 2. * DNWIND
END OF WIND DIRECTION LOOP
>
CXWIND : SRAD + X* PI8
≤
Q=Q* (Y-CXWIND) /Y
E

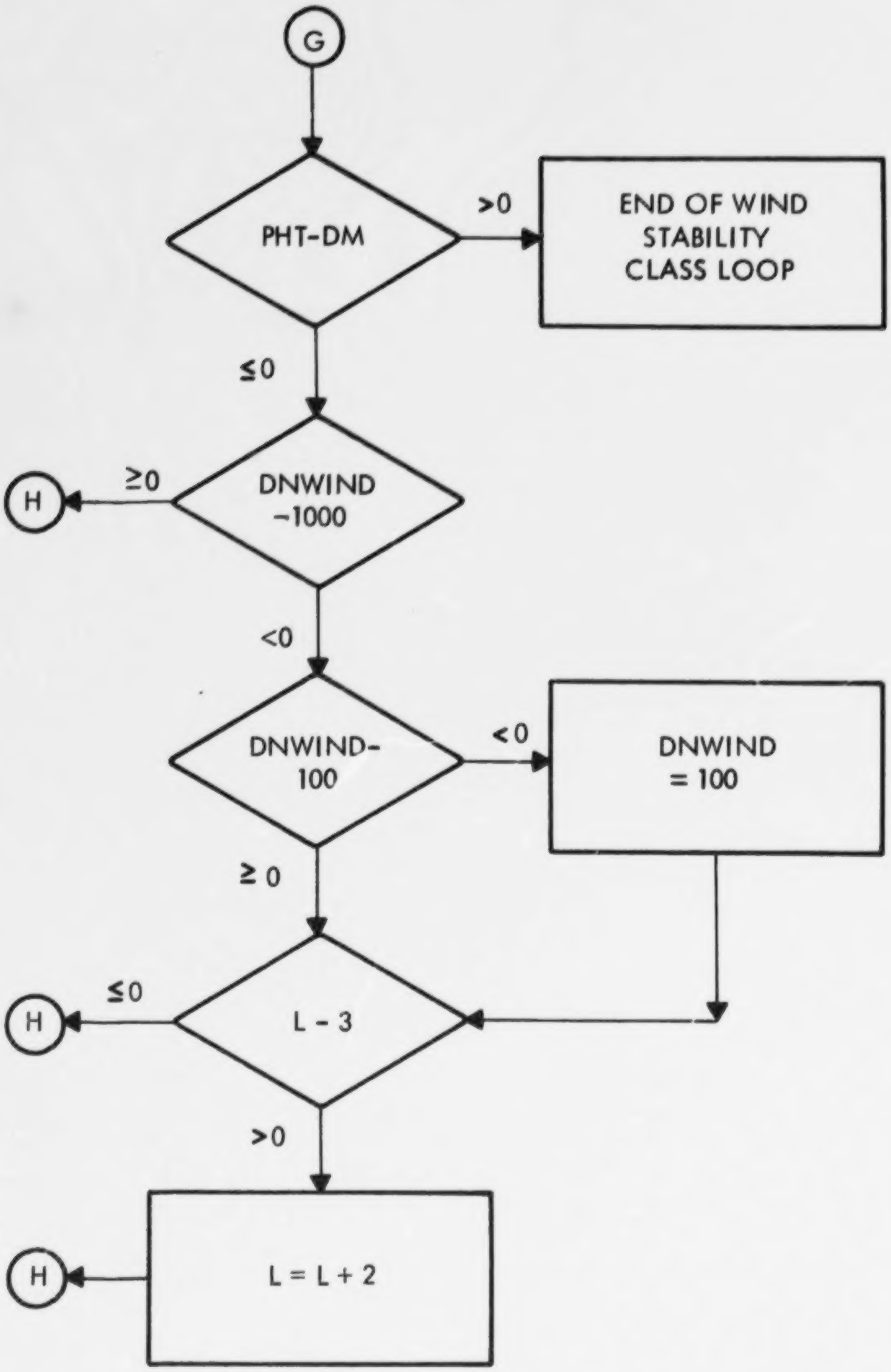
SUBROUTINE PØLUT (Continued)



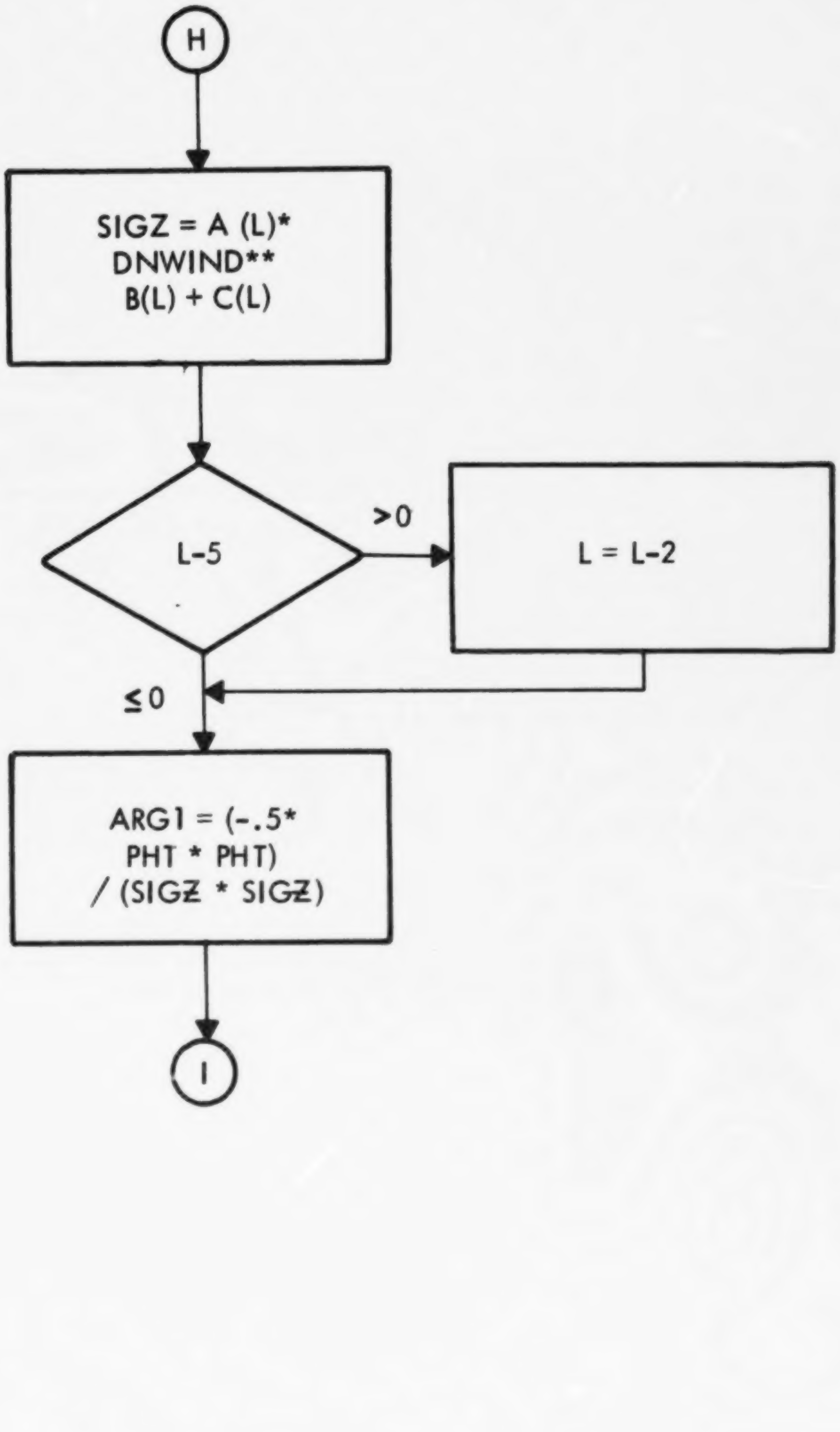
SUBROUTINE POLUT (Continued)


F
LOOK
1
2
3
4
5
6
DM = 1.5 * DM
FREQ = 1
L = 1
FREQ = 1
L = 2
FREQ = 1
L = 3
DM = 100
FREQ = 1
L = 5
DM = (DM + 100)/2
FREQ = .4
L = 4
FREQ = .6
L = 4
Y = Q*WNDFRQ(IWS, IWNDIR, L)*FREQ/U*100.
LOOK : 5
=
≠
L = 4
PLUME(3, ISORCE)
≤ 0
> 0
PLR(ISORCE) = PLUME(1, ISORCE)*PLUME(2, ISORCE)* (1.5 + .00268 *PA *PLUME(2, ISORCE) * (PLUME(3, ISORCE) -TA)/PLUME(3, ISORCE))
CC = FLOAT (L)
PHT = SORCE(6, ISORCE) + ((1.4- .1*CC) *PLR (ISORCE)/U)
G

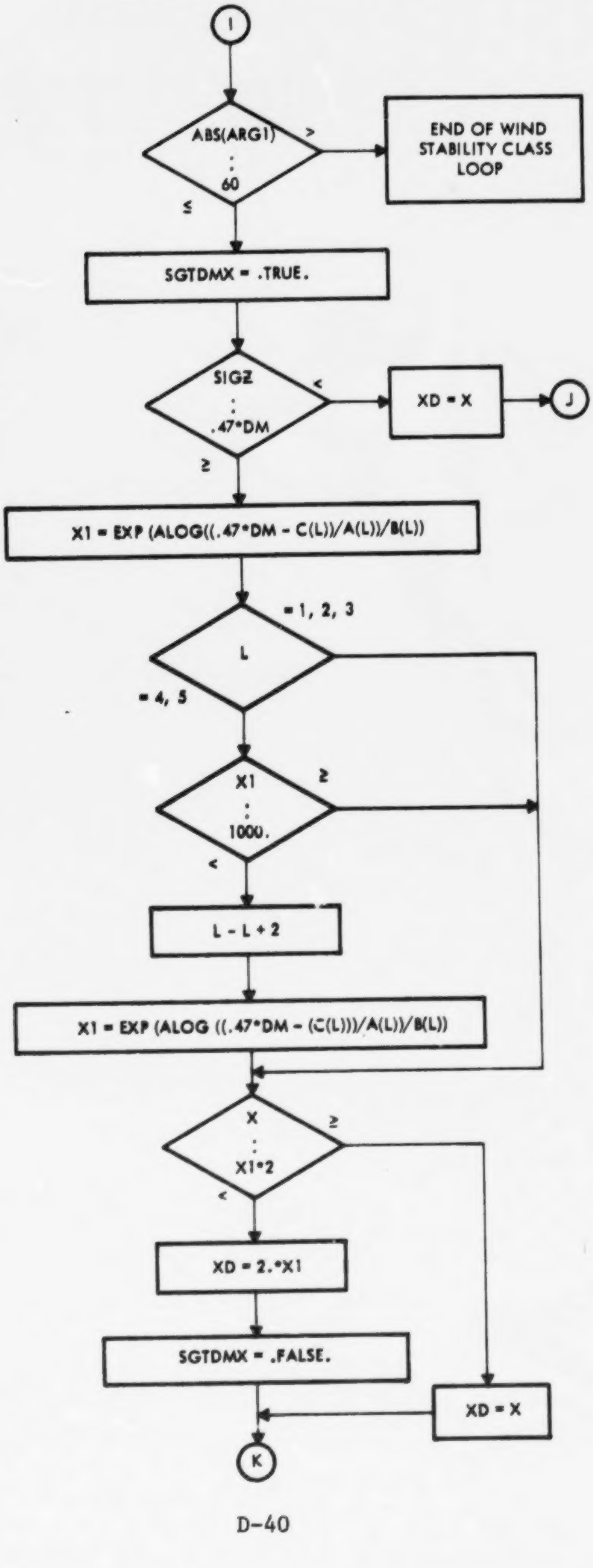
SUBROUTINE PØLUT (Continued)



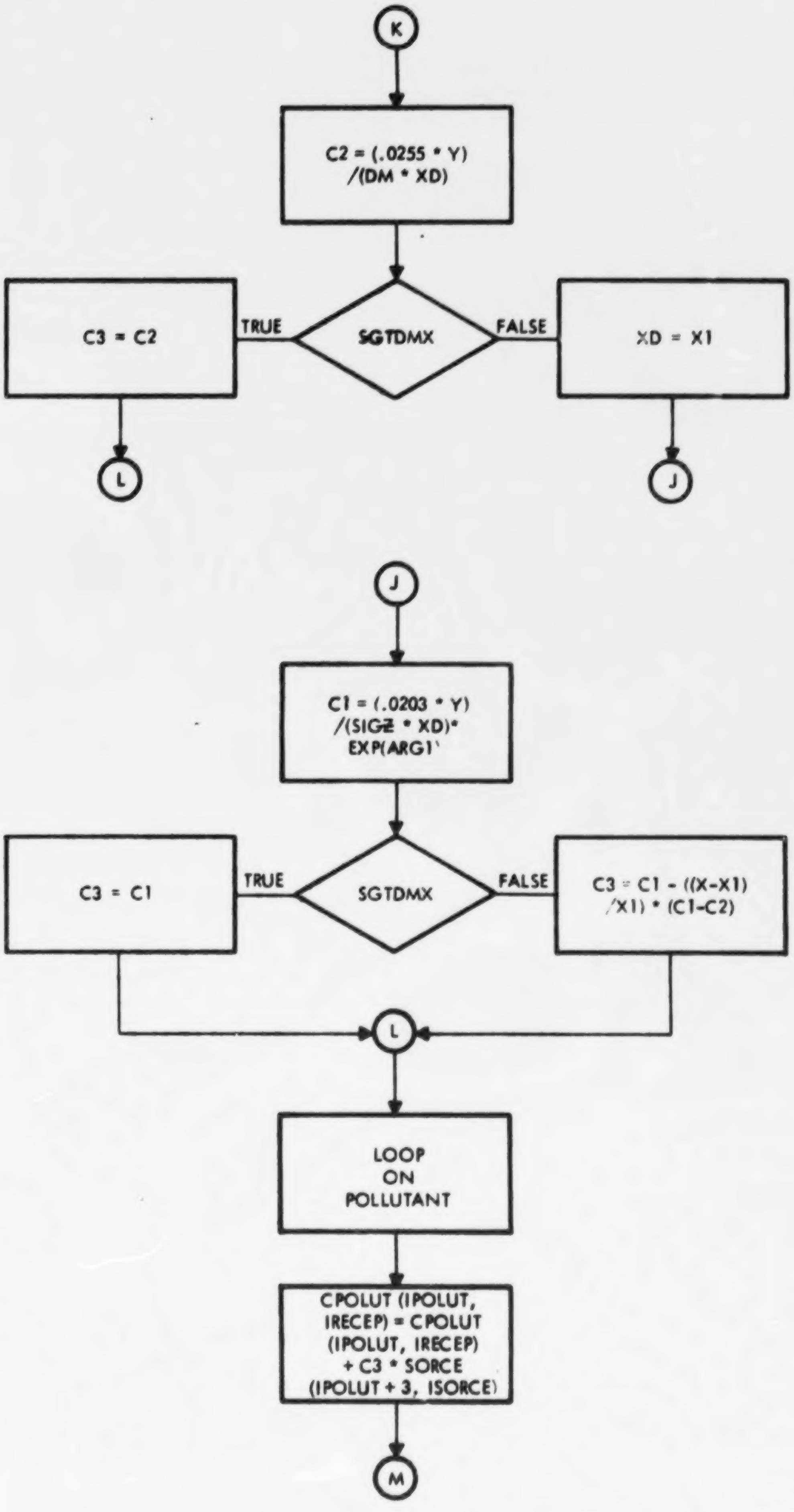
SUBROUTINE PØLUT (Continued)



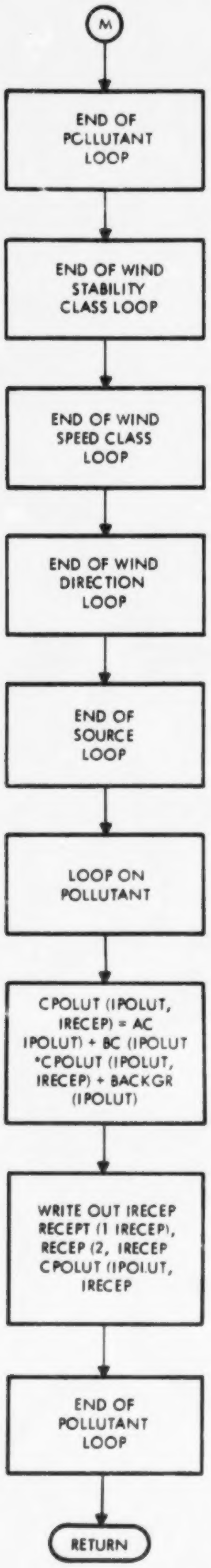
SUBROUTINE PØLUT (Continued)



SUBROUTINE PØLUT (Continued)


K
C2 = (.0255 * Y) /(DM * XD)
TRUE
SGTDMX
FALSE
C3 = C2
XD = X1
L
J
J
C1 = (.0203 * Y) /(SIGZ * XD)* EXP(ARG1)
TRUE
SGTDMX
FALSE
C3 = C1
C3 = C1 - ((X-X1) /X1) * (C1-C2)
L
LOOP ON POLLUTANT
CPOLUT (IPOLUT, IRECEP) = CPOLUT (IPOLUT, IRECEP) + C3 * SORCE (IPOLUT + 3, ISORCE)
M

SUBROUTINE PØLUT (Continued)


M
END OF POLLUTANT LOOP
END OF WIND STABILITY CLASS LOOP
END OF WIND SPEED CLASS LOOP
END OF WIND DIRECTION LOOP
END OF SOURCE LOOP
LOOP ON POLLUTANT
CPOLUT (IPOLUT, IRECEP) = AC IPOLUT) + BC (IPOLUT *CPOLUT (IPOLUT, IRECEP) + BACKGR (IPOLUT)
WRITE OUT IRECEP RECEPT (1 IRECEP), RECEP (2, IRECEP CPOLUT (IPOLUT, IRECEP
END OF POLLUTANT LOOP
RETURN

```
      SUBROUTINE POLUT
C
C     THE SUBROUTINE COMPUTES THE GROUND-LEVEL CONCENTRATIONS FOR
C     RECEPTORS CREATED IN DIFMOD.
C
C     *********************SPECIFICATION STATEMENTS*************************
      LOGICAL SGTDMX
C                   FOR SIGZ GREATER THAN DMIX — A LOGICAL VARIABLE
      DIMENSION PLR(200)
      COMMON /CONS/ PI4,PI8
      COMMON /CORD/ RBASE(2),DELTA,INCRX,INCRY,GDSCAL,QSCALE
       COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /LITL/ REGION(18)
      COMMON /LOGI/ SGTDMX
      COMMON /FIXX/ LINCT
      COMMON /RCPT/ RECEPT(2,237),CPOLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUTS(2,5),
     3              PTS(2,5)
      COMMON /REST/ A(7),B(7),C(7)
      COMMON /RGSN/ AC(2),BC(2),CORREL(100)
      COMMON /SRCE/ SORCE(6,1000),PLUME(3,1000),CS(2,1000),BACKGR(2),
     1              IFLAG,NSORCE,TA,PA
      COMMON /WIND/ WNDFRQ(6,16,5),UL(6),SINWD(16),COSWD(16),DPTHMX
C
      DO 9999 IPOLUT=IPOLU1,IPOLU2
      DO 9998 ISORCE=1,NSORCE
      CS(IPOLUT,ISORCE)=0.0
 9998 CONTINUE
 9999 CPOLUT(IPOLUT,IRECEP)=0.0
C     LOOP ON SOURCE                                              ISORCE
      DO  800 ISORCE=1,NSORCE
  181 SDIAM=SORCE (3,ISORCE)
C
C     SET UP FLAG FO POINT SOURCE
C
      SRAD=SDIAM/2.
  100 PHT= SORCE(6,ISORCE)
C     LOOP ON WIND DIRECTION                                      IWNDIR
      DO  700 IWNDIR=1,16
C
      DNWIND=GDSCAL*((SORCE (2,ISORCE)-RECEPT(2,IRECEP))*COSWD(IWNDIR)+
     1              (SORCE (1,ISORCE)-RECEPT(1,IRECEP))*SINWD(IWNDIR))
      X=DNWIND+SDIAM/PI8
      IF(SDIAM .GT. 100.) GO TO 110
      IF(X) 700, 700,120
  110 IF(SRAD+DNWIND)700,700,120
  120 CXWIND=GDSCAL*ABS((SORCE (2,ISORCE)-RECEPT(2,IRECEP))*
     1SINWD(IWNDIR)-(SORCE (1,ISORCE)-RECEPT(1,IRECEP))*COSWD(IWNDIR))
      Y=X*PI8
      IF(Y .LE. CXWIND) GO TO 70C
      IF( SRAD     .GT. ABS(DNWIND)) GC TO 130
      IF(SDIAM  .LE. (DNWIND*PI8)) GO TO 140
      G=QSCALE*((PI8*X-SDIAM)/SDIAM)
      DNWIND=SQRT((DNWIND*DNWIND)+(SRAD*SRAD))
C     FROM DNWIND=((4.*DNWIND**2.+SDIAM**2.)**.5)/2.
      X=2.*DNWIND
      IF(CXWIND-(SRAD+X*PI8))15C,150,700
  130 Q=QSCALE*(PI4*(X*X-4.08*X*SDIAM+4.1616*SDIAM*SDIAM))/(SRAD*SRAD*
     1                                                            16.)
C     FROM Q=QSCALE*(.1965*(X-2.040*SDIAM)**2.)/SDIAM**2.
      DNWIND=SINWD(3)*(DNWIND+SRAD)
C     WHERE SINWD(3) = SIN(PI8*2) OR SIN(PI/4) OR .70711
      X=DNWIND*2.
      IF(CXWIND-SRAD)150,150,700
  140 Q=QSCALE
  150 Q=Q*(Y-CXWIND)/Y
C     LOOP ON SEASON                                               ISEASN
C
      IWS=0
  574 IWS=IWS+1
 5515 U=UU(IWS)
 1240 CONTINUE
      DO 550 LOOK=1,6
      DM=DPTHMX
      FREQ=1.
      L=LOOK
      IF (LOOK.EQ.6) L=4
      IF (LOOK.EQ.4) FREQ=.4
      IF (LOOK.EQ.6) FREQ=.6
      IF (LOOK.EQ.1) DM=1.5*DM
      IF (LOOK.EQ.4) DM=(DM+100.)/2.
      IF (LOOK.EQ.5) DM=100.
 4327 Y = Q * WNDFRQ(IWS,IWNDIR,L) * FREQ / U * 100.
      IF (Y.LE.0) GO TO 550
      IF (LOOK.EQ.5) L=4
 5521 IF (PLUME(3,ISORCE))5522,5522,4328
 4328 PLR(ISORCE) = PLUME(1,ISORCE)*PLUME(2,ISORCE)*(1.5+.00268*PA*
     1  PLUME(2,ISORCE)*(PLUME(3,ISORCE)-TA)/PLUME(3,ISORCE))
      CC=FLOAT(L)
      PHT = SORCE(6,ISORCE) + ((1.4-.1*CC)*PLR(ISORCE)/U)
 5522 CONTINUE
      IF (PHT.GT.DM) GO TO 550
      IF (DNWIND.GE.1000.) GO TO 5526
      IF (DNWIND.LT.100.) DNWIND=100.
      IF (L.GT.3) L=L+2
 5526 SIGZ=A(L)*DNWIND**B(L)+C(L)
      IF (L.GT.5) L=L-2
      ARG1=(-.5*PHT*PHT)/(SIGZ*SIGZ)
      IF (ABS(ARG1).GT.60.) GO TO 550
      SGTDMX=.TRUE.                                                     POLU1000
      IF(SIGZ.LT..47*DM) GO TO 5527                                     POLU1010
 5528 X1=EXP(ALOG((.47*DM-(C(L)))/A(L))/B(L))                           POLU1020
      GO TO (5529,5529,5529,5530,5530),L                                POLU1030
 5530 IF (X1.GE.1000.) GO TO 5529                                       POLU1040
      L=L+2                                                             POLU1050
      X1=EXP(ALOG((.47*DM-(C(L)))/A(L))/B(L))                           POLU1060
 5529 IF (X.GE.X1*2.)GO TO 5531                                         POLU1070
      XD=2.*X1                                                          POLU1080
      SGTDMX=.FALSE.                                                    POLU1090
      GO TO 5532                                                        POLU1100
 5531 XD=X                                                              POLU1110
 5532 C2=(.0255*Y)/(DM*XD)                                              POLU1120
      IF (.NOT.SGTDMX) GO TO 5533                                       POLU1130
      C3=C2                                                             POLU1140
      GO TO 5000                                                        POLU1150
 5533 XD=X1                                                             POLU1160
      GO TO 5534                                                        POLU1170
 5527 XD=X                                                              POLU1180
 5534 C1=(.0203*Y)/(SIGZ*XD)*EXP(ARG1)                                  POLU1190
      C3=C1                                                             POLU1200
 5555 IF (.NOT.SGTDMX) C3=C1-((X-X1)/X1)*(C1-C2)                        POLU1210
C                                                                       POLU1220
 5000 DO 500 IPOLUT=IPOLU1,IPOLU2                                       POLU1230
      CPOLUT(IPOLUT,IRECEP)=CPOLUT(IPCLUT,IRECEP)+C3*SORCE (IPOLUT+3,   POLU1240
     1                    ISORCE)                                       POLU1250
  500 CONTINUE                                                          POLU1260
C     END OF LOOP ON POLLUTANTS                                         POLU1270
C                                                                       POLU1280
  550 CONTINUE                                                          POLU1290
C                                                                       POLU1300
C     END OF LOOP ON WIND STABILITY CLASS                               POLU1310
C                                                                       POLU1320
      IF (IWS.GE.6) GO TO 576                                           POLU1330
  575 GO TO 574                                                         POLU1340
  576 CONTINUE                                                          POLU1350
C                                                                       POLU1360
C     END OF LOOP ON WIND SPEED CLASS                                   POLU1370
C                                                                       POLU1380
  600 CONTINUE                                                          POLU1390
C                                                                       POLU1400
  700 CONTINUE                                                          POLU1410
C                                                                       POLU1420
C     END OF LOOP ON WIND DIRECTION                              IWNDIR POLU1430
C                                                                       POLU1440
  800 CONTINUE                                                          POLU1450
C                                                                       POLU1460
C     END OF LOOP ON SOURCE                                      ISORCE POLU1470
C                                                                       POLU1480
C                                                                       POLU1490
```

```
C     ADD BACKGROUND CONCENTRATION AND THEN CALIBRATE                   POLU1500
      DO 520 IPOLUT=IPOLU1,IPOLU2                                       POLU1510
      CPOLUT(IPOLUT,IRECEP)=AC(IPOLUT)+BC(IPOLUT)*(CPOLUT(IPOLUT,IRECEP)POLU1520
     1                        +BACKGR(IPOLUT))                          POLU1530
  520 CONTINUE                                                          POLU1540
C     RECEPTOR CONCENTRATIONS FOR EACH POLLUTANT,                       POLU1550
C                             FOR EACH SEASON                           POLU1560
C              IS NOW COMPLETE FOR THIS RECEPTOR.                       POLU1570
 8850 IF(LINCT.LT.52) GO TO 8940                                        POLU1580
      IF (IRECEP .EQ. 1) GO TO 825                                      POLU1590
      WRITE (6,6000)                                                    POLU1600
C                                                                       POLU1610
  825 LINCT=12                                                          POLU1620
      WRITE(6,3000) REGION                                              POLU1630
 3000 FORMAT('1',T10,18A4//)                                            POLU1640
      WRITE(6,6000)                                                     POLU1650
      WRITE(6,3005)                                                     POLU1660
 3005 FORMAT(T10,'|',T78,'|')                                           POLU1670
      WRITE(6,3010)                                                     POLU1680
 3010 FORMAT(T10,'|',T28,'RECEPTOR CONCENTRATION DATA',T78,'|')         POLU1690
      WRITE(6,6000)                                                     POLU1700
 6000 FORMAT(1H+,T10,'______________________________________________________POLU1710
     *__________________')                                              POLU1720
      WRITE(6,3015)                                                     POLU1730
 3015 FORMAT(T10,'|',T21,'|',T45,'|',T78,'|')                           POLU1740
      WRITE(6,3020)                                                     POLU1750
 3020 FORMAT(T10,'| RECEPTOR |   RECEPTOR LOCATION   |',6X,'EXPECTED ARIPOLU1760
     1THMETIC MEAN',T78,'|'/T10,'|  NUMBER  |',T45,'|',T78,'|')         POLU1770
      WRITE(6,6000)                                                     POLU1780
      WRITE(6,3025)                                                     POLU1790
 3025 FORMAT(T10,'|',T21,'|',T27,'(KILOMETERS)',T45,'|',T53,'(MICROGRAMSPOLU1800
     1/CU. METER)',T78,'|'/T10,'|',T21,'|',T26,'HORIZ',6X,'VERT    |',  POLU1810
     2   T53,'SO2',T64,'PARTICULATES',T78,'|')                          POLU1820
      WRITE(6,6000)                                                     POLU1830
      WRITE(6,3030)                                                     POLU1840
 3030 FORMAT(T10,'|',T21,'|',T33,'|',T45,'|',T62,'|',T78,'|')           POLU1850
 8940 WRITE(6,3035) IRECEP,RECEPT(1,IRECEP),RECEPT(2,IRECEP),CPOLUT(1,  POLU1860
     1  IRECEP),CPOLUT(2,IRECEP)                                        POLU1870
 3035 FORMAT(T10,  '|',T14,I3,T21,'|',3X,F6.1,2X,'|',2X,F6.1,3X,'|',4X, POLU1880
     1   F5.0,T62,'|',3X,F5.0,T78,'|')                                  POLU1890
      LINCT  = LINCT  + 1                                               POLU1900
      IF(MOD(IRECEP,3).EQ.0) WRITE(6,6000)                              POLU1910
  900 CONTINUE                                                          POLU1920
      RETURN                                                            POLU1930
      END                                                               POLU1940
```

SUBROUTINE PØLUT1*

Purpose:

To compute ground-level concentrations for CAMP stations.

Input:

Same as PØLUT

Output:

g.l.c. at CAMP stations

Procedure:

Same as PØLUT, but no calibration

Subroutine Called:

None

*Flow chart for this subroutine is same as the one for PØLUT.

```
      SUBROUTINE POLUT1(IPOLUT)
C
C     POLUT1 COMPUTES G.L.C. FOR CAMP STATIONS.
C
C     ********************SPECIFICATION STATEMENTS*************************
      LOGICAL SGTDMX
C                  FOR SIGZ GREAZER THAN DMIX -- A LOGICAL VARIABLE
C
      DIMENSION PLR(200)
      COMMON /CONS/ PI4,PI8
      COMMON /CORD/ RBASE(2),DELTA,INCRX,INCRY,GDSCAL,QSCALE
       COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /LITL/ REGION(18)
      COMMON /LOGI/ SGTDMX
      COMMON /RCPT/ DUMMY(474),CPOLUT(2,237),RECEPT(2,100,2),SO2OBS(100)
     1              ,PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUT5(2,5),
     3              PT5(2,5),NRECEP
       COMMON /REST/ A(7),B(7),C(7)
       COMMON /SRCE/ SORCE(6,1000),PLUME(3,1000),CS(2,1000),BACKGR(2),
     1              IFLAG,NSORCE,TA,PA
       COMMON /WIND/ WNDFRQ(6,16,5),UU(6),SINWD(16),COSWD(16),DPTHMX
C
      CPOLUT(IPOLUT,IRECEP)=0.
C     LOOP ON SOURCE                                              ISORCE
      DO  800 ISORCE=1,NSORCE
  181 SDIAM=SORCE (3,ISORCE)
C
      SRAD=SDIAM/2.
  100 PHT= SORCE(6,ISORCE)
C     LOOP ON WIND DIRECTION                                      IWNDIR
      DO  700 IWNDIR=1,16
C
      DNWIND=GDSCAL*((SORCE(2,ISORCE)-RECEPT(2,IRECEP,IPOLUT))*
     1   COSWD(IWNDIR)+(SORCE(1,ISORCE)-RECEPT(1,IRECEP,IPOLUT))*
     2        SINWD(IWNDIR))
      X=DNWIND+SDIAM/PI8
      IF(SDIAM .GT. 100.) GO TO 110
      IF(X) 700, 700,120
  110 IF(SRAD+DNWIND)700,700,120
  120 CXWIND=GDSCAL*ABS((SORCE(2,ISORCE)-RECEPT(2,IRECEP,IPOLUT))*
     1   SINWD(IWNDIR)-(SORCE(1,ISORCE)-RECEPT(1,IRECEP,IPOLUT))*
     2        COSWD(IWNDIR))
      Y=X*PI8
      IF(Y .LE. CXWIND) GO TO 700
      IF( SRAD     .GT. ABS(DNWIND)) GO TO 130
      IF(SDIAM  .LE. (DNWIND*PI8)) GO TO 140
      Q=QSCALE*((PI8*X-SDIAM)/SDIAM)
      DNWIND=SQRT((DNWIND*DNWIND)+(SRAD*SRAD))
C     FROM DNWIND=((4.*DNWIND**2.+SDIAM**2.)**.5)/2.
```

```
      X=2.*DNWIND
      IF(CXWIND-(SRAD+X*PI8))150,150,700
  130 Q=QSCALE*(PI4*(X*X-4.08*X*SDIAM+4.1616*SDIAM*SDIAM))/(SRAD*SRAD*
     1
C     FROM Q=QSCALE*(.1965*(X-2.040*SDIAM)**2.)/SDIAM**2.             16.)
      DNWIND=SINWD(3)*(DNWIND+SRAD)
C     WHERE SINWD(3) = SIN(PI8*2) OR SIN(PI/4) OR .70711
      X=DNWIND*2.
      IF(CXWIND-SRAD)150,150,700
  140 Q=QSCALE
  150 Q=Q*(Y-CXWIND)/Y
C
      IWS=0
  574 IWS=IWS+1
 5515 U=UU(IWS)
 1240 CONTINUE
      DO 550 LOOK=1,6
      DM=DPTHMX
      FREQ=1.
      L=LOOK
      IF (LOOK.EQ.6) L=4
      IF (LOOK.EQ.4) FREQ=.4
      IF (LOOK.EQ.6) FREQ=.6
      IF (LOOK.EQ.1) DM=1.5*DM
      IF (LOOK.EQ.4) DM=(DM+100.)/2.
      IF (LOOK.EQ.5) DM=100.
 4327 Y = Q * WNDFRQ(IWS,IWNDIR,L) * FREQ / U * 100.
      IF (Y.LE.0) GO TO 550
      IF (LOOK.EQ.5) L=4
 5521 IF (PLUME(3,ISORCE))5522,5522,4328
 4328 PLR(ISORCE) = PLUME(1,ISORCE)*PLUME(2,ISORCE)*(1.5+.00268*PA*
     1  PLUME(2,ISORCE)*(PLUME(3,ISORCE)-TA)/PLUME(3,ISORCE))
      CC=FLOAT(L)
      PHT = SORCE(6,ISORCE) + ((1.4-.1*CC)*PLR(ISORCE)/U)
 5522 CONTINUE
      IF (PHT.GT.DM) GO TO 550
      IF (DNWIND.GE.1000.) GO TO 5526
      IF (DNWIND.LT.100.) DNWIND=100.
      IF (L.GT.3) L=L+2
 5526 SIGZ=A(L)*DNWIND**B(L)+C(L)
      IF (L.GT.5) L=L-2
      ARG1=(-.5*PHT*PHT)/(SIGZ*SIGZ)
      IF (ABS(ARG1).GT.60.) GO TO 550
      SGTDMX=.TRUE.
      IF(SIGZ.LT..47*DM) GO TO 5527
 5528 X1=EXP(ALOG((.47*DM-(C(L)))/A(L))/B(L))
      GO TO (5529,5529,5529,5530,5530),L
 5530 IF (X1.GE.1000.) GO TO 5529
      L=L+2
      X1=EXP(ALOG((.47*DM-(C(L)))/A(L))/B(L))
 5529 IF (X.GE.X1*2.)GO TO 5531                                                     POL11000
      XD=2.*X1                                                                     POL11010
      SGTDMX=.FALSE.                                                               POL11020
      GO TO 5532                                                                   POL11030
 5531 XD=X                                                                         POL11040
 5532 C2=(.0255*Y)/(DM*XD)                                                         POL11050
      IF (.NOT.SGTDMX) GO TO 5533                                                  POL11060
      C3=C2                                                                        POL11070
      GO TO 5000                                                                   POL11080
 5533 XD=X1                                                                        POL11090
      GO TO 5534                                                                   POL11100
 5527 XD=X                                                                         POL11110
 5534 C1=(.0203*Y)/(SIGZ*XD)*EXP(ARG1)                                             POL11120
      C3=C1                                                                        POL11130
 5555 IF (.NOT.SGTDMX) C3=C1-((X-X1)/X1)*(C1-C2)                                   POL11140
C                                                                                  POL11150
 5000 CONTINUE                                                                     POL11160
      SC = C3 * SORCE(IPOLUT+3,ISORCE)                                             POL11170
  402 CPOLUT(IPOLUT,IRECEP)=CPOLUT(IPOLUT,IRECEP)+SC                               POL11180
C                                                                                  POL11190
  550 CONTINUE                                                                     POL11200
C                                                                                  POL11210
C     END OF LOOP ON WIND STABILITY CLASS                                          POL11220
C                                                                                  POL11230
      IF (IWS.GE.6) GO TO 576                                                      POL11240
  575 GO TO 574                                                                    POL11250
  576 CONTINUE                                                                     POL11260
C                                                                                  POL11270
C     END OF LOOP ON WIND SPEED CLASS                                              POL11280
C                                                                                  POL11290
  600 CONTINUE                                                                     POL11300
C                                                                                  POL11310
  700 CONTINUE                                                                     POL11320
C                                                                                  POL11330
C     END OF LOOP ON WIND DIRECTION                                         IWNDIR POL11340
C                                                                                  POL11350
  800 CONTINUE                                                                     POL11360
C                                                                                  POL11370
C     END OF LOOP ON SOURCE                                                 ISORCE POL11380
  850 CONTINUE                                                                     POL11390
C                                                                                  POL11400
C     ADD BACKGROUND CONCENTRATION                                                 POL11410
      CPOLUT(IPOLUT,IRECEP)=CPOLUT(IPOLUT,IRECEP)+BACKGR(IPOLUT)                   POL11420
  900 CONTINUE                                                                     POL11430
      RETURN                                                                       POL11440
      END                                                                          POL11450
```

SUBROUTINE PØLUT2*

Purpose:

To compute source contributions either to five selected receptors or to the five maximum concentration receptors.

Input:

Same as PØLUT

Output:

CS (2, 1000) -------------------- source contributions

Procedure:

1. Initialize CS array to zero.
2. Determine the receptor-source geometry.
3. Compute transfer coefficient, C3.
4. Multiply C3 and source intensity, SINTEN.

Subroutine Called:

None

*Flow chart for this subroutine is same as the one for PØLUT.

```
      SUBROUTINE POLUT2(IPOLUT,ISORCE)
C
C     POLUT2 CALCULATES THE INDIVIDUAL SCURCE CONTRIBUTIONS FOR
C     EITHER THE 5 SELECTED RECEPTORS OF THE 5 MAX. RECEPTORS.
C
C     *******************SPECIFICATION STATEMENTS***********************
      LOGICAL SGTDMX
                    FOR SIGZ GREATER THAN DMIX -- A LOGICAL VARIABLE
C
      DIMENSION PLR(200)
      COMMON /CONS/ PI4,PI8
      COMMON /CORD/ RBASE(2),DELTA,INCRX,INCRY,GDSCAL,QSCALE
       COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /LITL/ REGION(18)
      COMMON /LOGI/ SGTDMX
      COMMON /RCPT/ RECEPT(2,237),CPCLUT(2,237),SO2LOC(2,100),
                    PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     1              IRECEP,XRECEP(2,12),IADD,JRECEP(2.237),POLUT5(2,5),
     2              PT5(2,5)
     3
       COMMON /REST/ A(7),B(7),C(7)
       COMMON /RGSN/ AC(2),BC(2),CORREL(100)
       COMMON /SRCE/ SORCE(6,100C),PLUME(3,1000),CS(2,1000),BACKGR(2),
     1              IFLAG,NSORCE,TA,PA
       COMMON /WIND/ WNDFRQ(6,16,5),UU(6),SINWD(16),COSWD(16),DPTHMX
C
  181 SDIAM=SORCE (3,ISORCE)
C
      SRAD=SDIAM/2.
C
  100 PHT= SORCE(6,ISORCE)                                          IWNDIR
C     LOOP ON WIND DIRECTION
      DO  700 IWNDIR=1,16
C
      DNWIND=GDSCAL*((SORCE (2,ISORCE)-RECEPT(2,IRECEP))*COSWD(IWNDIR)+
     1              (SORCE (1,ISORCE)-RECEPT(1,IRECEP))*SINWD(IWNDIR))
      X=DNWIND+SDIAM/PI8
      IF(SDIAM .GT. 1C0.) GO TO 110
      IF(X) 700, 700,12C
  110 IF(SRAD+DNWIND)700,700,120
  120 CXWIND=GDSCAL*ABS((SORCE (2,ISORCE)-RECEPT(2,IRECEP))*
     1SINWD(IWNDIR)-(SORCE (1,ISORCE)-RECEPT(1,IRECEP))*COSWD(IWNDIR))
      Y=X*PI8
      IF(Y .LE. CXWIND) GO TO 700
      IF( SRAD      .GT. ABS(DNWIND)) GO TC 130
      IF(SDIAM  .LE. (DNWIND*PI8)) GO TO 140
      Q=QSCALE*((PI8*X-SDIAM)/SDIAM)
      DNWIND=SQRT((DNWIND*DNWIND)+(SRAD*SRAD))
C     FROM DNWIND=((4.*DNWIND**2.+SDIAM**2.)**.5)/2.
      X=2.*DNWIND
      IF(CXWIND-(SRAD+X*PI8))15C,150,700
  130 Q=QSCALE*(PI4*(X*X-4.08*X*SDIAM+4.1616*SDIAM*SDIAM))/(SRAD*SRAD*
     1                                                            16.)
C     FROM Q=QSCALE*(.1965*(X-2.040*SDIAM)**2.)/SDIAM**2.
      DNWIND=SINWD(3)*(DNWIND+SRAD)
C     WHERE SINWD(3) = SIN(PI8*2) OR SIN(PI/4) OR .70711
      X=DNWIND*2.
      IF(CXWIND-SRAD)150,150,700
  140 Q=QSCALE
  150 Q=Q*(Y-CXWIND)/Y
C
      IWS=0
  574 IWS=IWS+1
 5515 U=UU(IWS)
 1240 CONTINUE
      DO 550 LOOK=1,6
      DM=DPTHMX
      FREQ=1.
      L=LOOK
      IF (LOOK.EQ.6) L=4
      IF (LOOK.EQ.4) FREQ=.4
      IF (LOOK.EQ.6) FREQ=.6
      IF (LOOK.EQ.1) DM=1.5*DM
      IF (LOOK.EQ.4) DM=(DM+100.)/2.
      IF (LOOK.EQ.5) DM=100.
 4327 Y = Q * WNDFRQ(IWS,IWNDIR,L) * FREQ / U * 100.
      IF (Y.LE.0) GO TO 550
      IF (LOOK.EQ.5) L=4
 5521 IF (PLUME(3,ISORCE))5522,5522,4328
 4328 PLR(ISORCE) = PLUME(1,ISORCE)*PLUME(2,ISORCE)*(1.5+.00268*PA*
     1  PLUME(2,ISORCE)*(PLUME(3,ISORCE)-TA)/PLUME(3,ISORCE))
      CC=FLOAT(L)
      PHT = SORCE(6,ISORCE) + ((1.4-.1*CC)*PLR(ISORCE)/U)
 5522 CONTINUE
      IF (PHT.GT.DM) GO TO 550
      IF (DNWIND.GE.1000.) GO TO 5526
      IF (DNWIND.LT.100.) DNWIND=100.
      IF (L.GT.3) L=L+2
 5526 SIGZ=A(L)*DNWIND**B(L)+C(L)
      IF (L.GT.5) L=L-2
      ARG1=(-.5*PHT*PHT)/(SIGZ*SIGZ)
      IF (ABS(ARG1).GT.60.) GO TO 550
      SGTDMX=.TRUE.
      IF(SIGZ.LT..47*DM) GO TO 5527
 5528 X1=EXP(ALOG((.47*DM-(C(L)))/A(L))/B(L))
      GO TO (5529,5529,5529,5530,5530),L
 5530 IF (X1.GE.1000.) GO TO 5529
      L=L+2
      X1=EXP(ALOG((.47*DM-(C(L)))/A(L))/B(L))
 5529 IF (X.GE.X1*2.)GO TO 5531
      XD=2.*X1
      SGTDMX=.FALSE.
      GO TO 5532
 5531 XD=X
 5532 C2=(.0255*Y)/(DM*XD)
      IF (.NOT.SGTDMX) GO TO 5533
      C3=C2
      GO TO 5000
 5533 XD=X1
      GO TO 5534
 5527 XD=X
 5534 C1=(.0203*Y)/(SIGZ*XD)*EXP(ARG1)
      C3=C1
 5555 IF (.NOT.SGTDMX) C3=C1-((X-X1)/X1)*(C1-C2)
C
 5000 CONTINUE
      SC = C3 * SORCE(IPOLUT+3,ISORCE)
      CS(IPOLUT,ISORCE)=CS(IPOLUT,ISORCE)+SC
C
  550 CONTINUE
C
C     END OF LOOP ON WIND STABILITY CLASS
C
      IF (IWS.GE.6) GO TO 576
  575 GO TO 574
  576 CONTINUE
C
C     END OF LOOP ON WIND SPEED CLASS
C
C
  700 CONTINUE
C
C     END OF LOOP ON WIND DIRECTION                                      IWNDIR
C
      RETURN
      END
```

SUBROUTINE REG

Purpose:

Computations of y-intercepts, slope and correlation coefficients between observed and calculated ground-level concentrations at specified CAMP stations.

Input:

0P0LUT (100, 2) ---------------- observed ground-level concentrations

CP0LUT (2, 237) ---------------- computed ground-level concentrations

RECEPT (2, 237, 2) ------------- receptor locations

C0RREL (100) ------------------- correlation table

NS02 --------------------------- number of sulfur dioxide CAMP stations

NPART -------------------------- number of particulate CAMP stations

Output:

AC (2) ------------------------- y-intercept

BC (2) ------------------------- slopes

Procedure:

CP ----------------------------- computed ground-level concentrations

OP ----------------------------- observed ground-level concentrations

AN ----------------------------- number of receptors

1. Compute:

   A) $SX = \Sigma CP$, $SY = \Sigma OP$
   B) $SX2 = \Sigma(CP)^2$, $SY2 = \Sigma(OP)^2$
   C) $SXY = \Sigma(CP \cdot OP)$

2. Compute:

   A) $TSX = \Sigma(CP)^2 - (\Sigma CP)^2/AN$
   B) $TSY = \Sigma(OP)^2 - (\Sigma OP)^2/AN$
   C) $TXY = \Sigma(CP \cdot OP) - (\Sigma CP) \cdot (\Sigma OP)/AN$

3. Compute:

   A) $XM = \Sigma CP/AN$
   B) $YM = \Sigma OP/AN$

SUBROUTINE REG (Continued)

4. Compute:

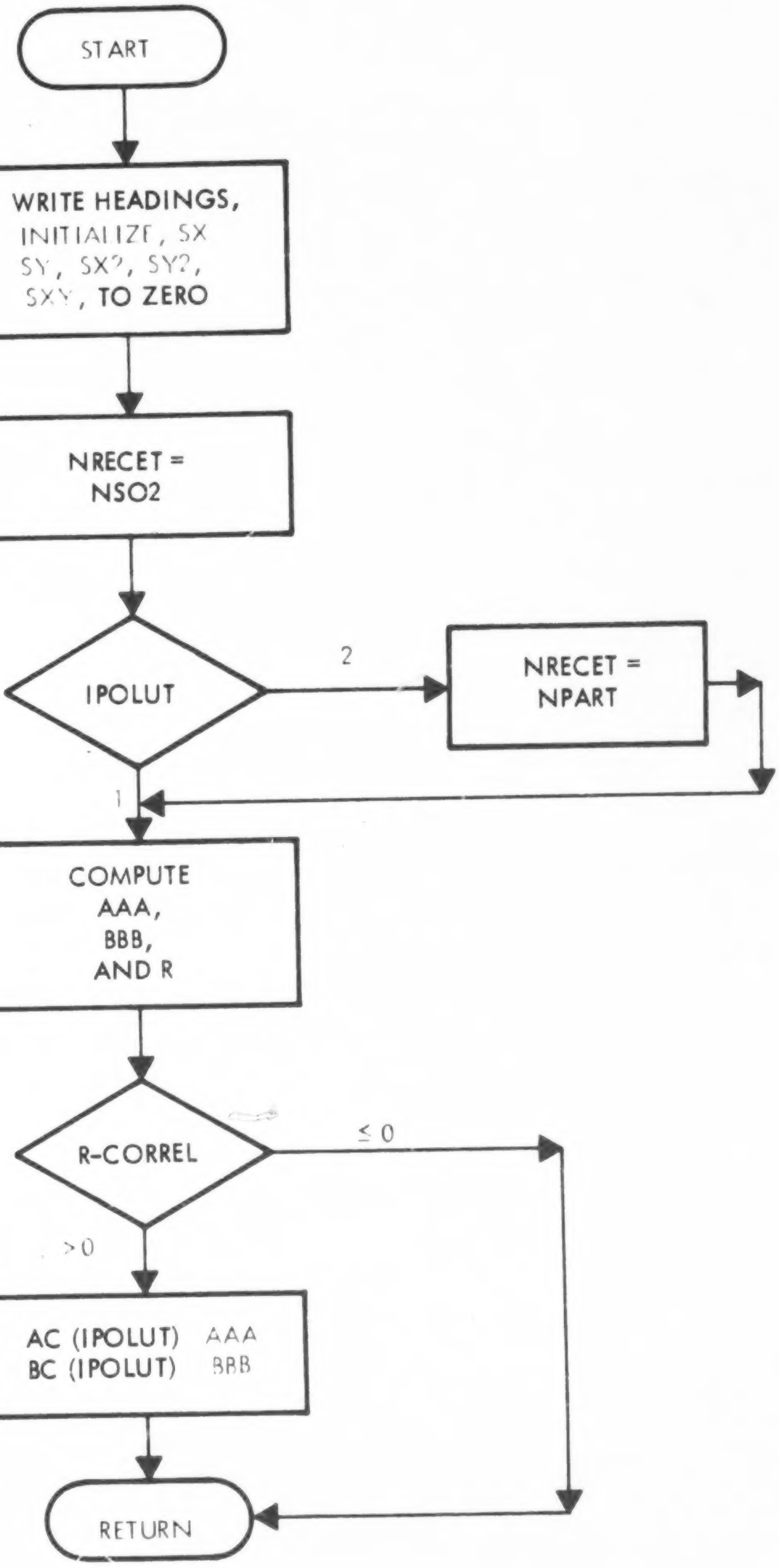
   A) Slope = TXY/TSX
   B) Y-intercept = YM - slope*XM

5. Calculate the correlation coefficient and test against the table (input).

Subroutine Called:

None

SUBROUTINE REG



```
      SUBROUTINE REG(IPOLUT)
C              THIS SUBROUTINE COMPUTES THE Y-INTERCEPT, SLOPE,AND
C             CORRELATION COEFFICIENT OF REGRESSION EQ. BETWEEN
C              OBSERVED CONCENTRATION AND CALCULATED CONCENTRATION.
C              AC.........Y-INTERCEPT
C              BC.........SLOPE
C
       COMMON /DOLP/ IPOLU1,IPOLU2,INC(2),JFL
      COMMON /LITL/ REGION(18)
      COMMON /RCPT/ DUMMY(474),CPOLUT(2,237),RECEPT(2,100,2),
     1              OPOLUT(100,2),NSO2,NPART,IRECEP,
     2              KRECEP(2,12),IADD,JRECEP(2,237),POLUT5(2,5),PT5(2,5)
     3              ,NRECEP
      COMMON /RGSN/ AC(2),BC(2),CORREL(100)
      COMMON /SRCE/ SORCE(6,1000),PLUME(3,1000),CS(2,1000),BACKGR(2),
     1              IFLAG,NSORCE,TA,PA
      REAL*8 A(4),B(4),BB(2),C(6),CC(3)
      DATA A/'SO2                ','PARTICULATES    '/
      DATA B/'                   ','POOR CORRELATION'/
      DATA C/'                                 ',', COEFFICIENTS NOT USED.'/
C
      BB(1)=B(1)
      BB(2)=B(2)
      CC(1) = C(1)
      CC(2) = C(2)
      CC(3) = C(3)
C
      SX=0.
      SY=0.
      SX2=0.
      SY2=0.
      SXY=0.
      NRECEP=NSO2
      IF (IPOLUT.EQ.2) NRECEP=NPART
      DO 920 IRECEP=1,NRECEP
  800 OP=OPOLUT(IRECEP,IPOLUT)
      CP=CPOLUT(IPOLUT,IRECEP)
      SX=SX+CP
      SY=SY+OP
      SX2=SX2+CP*CP
      SY2=SY2+OP*OP
  920 SXY=SXY+OP*CP
      AN=FLOAT(NRECEP)
      TSX=SX2-SX*SX/AN
      TSY=SY2-SY*SY/AN
      TXY=SXY-(SX*SY)/AN
      XM=SX/AN
      YM=SY/AN
      BBB=TXY/TSX
      AAA=YM-BBB*XM
      R=TXY/SQRT(TSX*TSY)                                               REG  500
      NDF=NRECEP-2                                                      REG  510
      IF(R.GT.CORREL(NDF)) GO TO 921                                    REG  520
      BB(1)=B(3)                                                        REG  530
      BB(2)=B(4)                                                        REG  540
      CC(1) = C(4)                                                      REG  550
      CC(2) = C(5)                                                      REG  560
      CC(3) = C(6)                                                      REG  570
      GO TO 930                                                         REG  580
  921 AC(IPOLUT)=AAA                                                    REG  590
      BC(IPOLUT)=BBB                                                    REG  600
  930 IF(JFL.GT.0) GO TO 2019                                           REG  610
      WRITE(6,2000) REGION                                              REG  620
 2000 FORMAT('1',T15,18A4/)                                             REG  630
      WRITE(6,2015)                                                     REG  640
 2015 FORMAT(//T10,'REGRESSION PARAMETERS FOR CALCULATED (X-AXIS) VS. OBREG  650
     1SERVED (Y-AXIS) CONCENTRATIONS'//T15,'POLLUTANT',T35,'Y-INTERCEPT'REG  660
     2   ,T58,'SLOPE',T72,'REGRESSION COEFFICIENTS'/T30,'(MICROGRAMS/CU.REG  670
     3 METER)',T69,'COMPUTED',T83,'5% CONF. LEVEL'/'+',T14,'___________'REG  680
     4   ,T29,'_________________________',T56,'________',T68,'__________'REG  690
     5   ,T82,'_________________'/)                                     REG  700
      JFL = 1                                                           REG  710
 2019 J=IPOLUT*2 - 1                                                    REG  720
      K = J+1                                                           REG  730
      WRITE(6,2020) (A(I),I=J,K), AAA, BBB,                             REG  740
     1     R,CORREL(NDF),BB,CC                                          REG  750
 2020 FORMAT(T14,2A8,T37,F7.1,T57,F7.4,T70,F6.3,T83,F6.3,2X,2A8,3A8)    REG  760
  980 CONTINUE                                                          REG  770
      RETURN                                                            REG  780
      END                                                               REG  790
```

SUBROUTINE SEL12

Purpose:

Compute the geometric mean concentrations, the maximum concentrations, and concentrations for three percentiles for up to five averaging times. Output these values for the 12 selected receptors.

Input:

ISEL12 (2, 12) -------------- 12 selected receptor numbers
STANDV (2, 12) -------------- standard deviations for pollutants
AVRGTM (2, 3) --------------- averaging times
XP (2, 12) ------------------ arithmetic mean concentration values for the 12 receptors

Output:

IRECEP ---------------------- receptor number
XP (2, 12) ------------------ arithmetic mean concentrations
GEOM ------------------------ geometric mean concentrations
CMAX ------------------------ maximum concentrations
CPER (3)--------------------- percentile concentration
AVRGTM (2, 3) --------------- averaging times
STANDV (2, 12) -------------- standard deviations

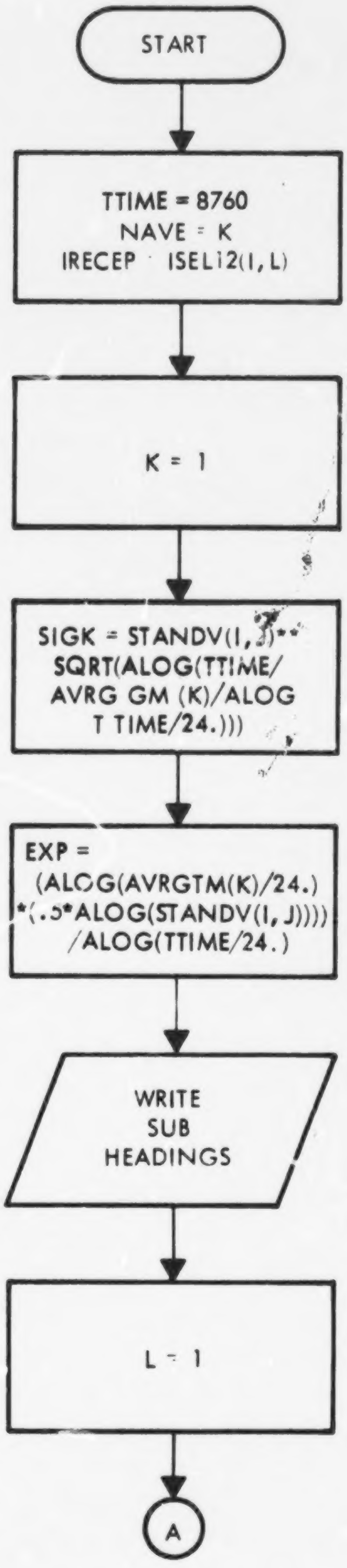
Procedure:

1. Compute standard deviation (SIGK) for averaging time K.
2. Compute exponent for converting the averaging time of the geometric mean.
3. Write headers.
4. Compute the geometric mean, the maximum concentration, and three percentile concentrations per averaging time, receptor and pollutant.
5. Output these values.
6. Do 1 through 5 until all receptors have been computed and are output.

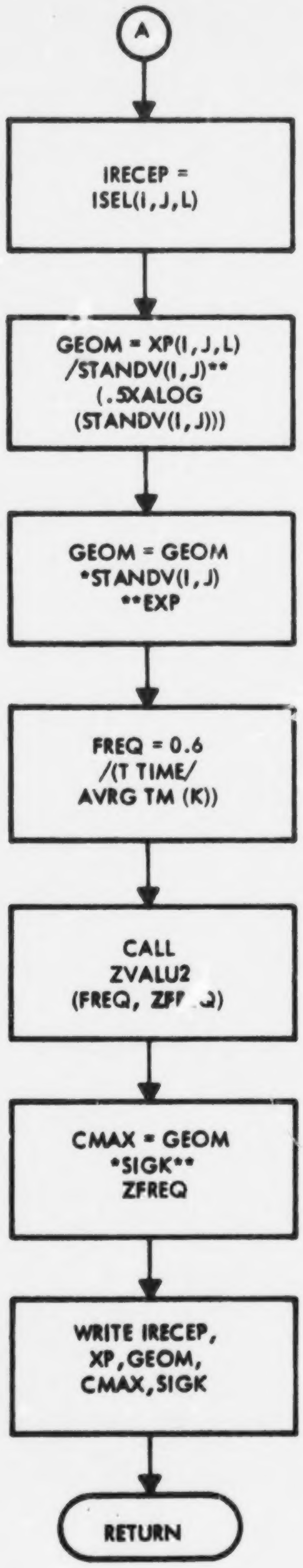
Subroutine Called:

ZVALU2(FREQ, ZFREQ)

SUBROUTINE SEL12



SUBROUTINE SEL12 (Continued)


A
IRECEP = ISEL(I,J,L)
GEOM = XP(I,J,L) /STANDV(I,J)** (.5XALOG (STANDV(I,J)))
GEOM = GEOM *STANDV(I,J) **EXP
FREQ = 0.6 /(T TIME/ AVRG TM (K))
CALL ZVALU2 (FREQ, ZFREQ)
CMAX = GEOM *SIGK** ZFREQ
WRITE IRECEP, XP,GEOM, CMAX,SIGK
RETURN

```
      SUBROUTINE  SEL12
C
      COMMON /AIRQ/ AVRGTM(2,3),STANDV(2,12)
      COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /LITL/ REGION(18)
      COMMON /RCPT/ RECEPT(2,237),CPOLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUT5(2,5),
     3              PT5(2,5)
      COMMON /SELC/ ISEL12(2,12),NSEL12,ISEL5(2,5),NSEL5,XP(2,12)
      REAL*8 A(4)/'SO2     ','        ','PARTICUL','ATES    '/
C
C  SEL12 WILL COMPUTE,THE GEOMETRIC MEAN (GEOM), THE MAXIMUM
C     CONCENTRATION (CMAX),FOR 3 AVERAGING TIMES PER POLLUTANT
C                                FOR THE 12 SELECTED RECEPTORS.
C                                  START POLLUTANT LOOP.
   15 DO 300 I = IPOLU1,IPOLU2
      IF (ISEL12(I,1)   .EQ. 0) GO TO 300
C
C   COMPUTE TOTAL TIME
C
      TTIME = 8760.
C                        SET AVE. TIME LOCP
      DO  10 K = 1,3
C                    TEST FOR  NUMBER OF AVE.TIMES
      IF (AVRGTM(I,K) .LE. 0.) GO TO 30
      NAVE = K
   10 CONTINUE
C                         START AVE. TIME LOOP.
   30 DO 200 K = 1,NAVE
C                            SET 12 RECEPTOR LOOP.
      DO 199 L = 1,12
C                       GET RECEPTOR NUMBER FOR  POLUT
      IRECEP = ISEL12(I,L)
      IF(IRECEP .LE. 0) GO TO 300
C
C                         COMPUTE STAND DEV. FOR AVE. TIME K.
      SIGK = STANDV(I,L)**(SQRT(ALOG(TTIME     /AVRGTM(I,K))
    1        / ALOG(TTIME       / 24.)))
C  COMPUTE EXPONENT FOR CONVERTING GEOM. MEAN TO AVE. TIME K.
      EXP = (ALOG(AVRGTM(I,K)/24.) * (.5 * ALOG(STANDV(I,L))))
    1       / ALOG(TTIME       / 24.)
      IF (L .GT. 1) GO TO 50
C
C                                      WRITE HEADER LINE.
      J1 = I*2-1
      J2 = J1 + 1
      WRITE(6,990) REGION,(A(M),M=J1,J2)
C
C   WRITE AVE. TIME
```

```
      WRITE (6,991) AVRGTM(I,K)
      WRITE(6,993)
C
C  COMPUTE GEOM. MEAN  USING ARITH. MEAN (XP)
   50 GEOM = XP(I,L) / STANDV(I,L)**(.5*ALCG(STANDV(I,L)))
C
C  COMPUTE  GEOM. MEAN AT AVE. TIME K
      GEOM = GEOM * STANDV(I,L)** EXP
C
C  COMPUTE MAXIMUM CONCENTRATION FOR AVERAGE TIME K
C
      FREQ = 0.6 / (TTIME      / AVRGTM(I,K))
C
      CALL ZVALU2(FREQ,ZFREQ)
C
      CMAX = GEOM * SIGK**ZFREQ
C
C              WRITE O/P DATA LINE
      WRITE(6,994)
      WRITE (6,992) IRECEP,XP(I,L),GEOM,CMAX,SIGK
      WRITE(6,993)
C
  199 CONTINUE
      WRITE(6,994)
      WRITE(6,993)
  200 CONTINUE
  300 CONTINUE
C
      RETURN
C
C
  990 FORMAT('1',T10,18A4,  //
     .             T10,'STATISTICAL DATA FCR SELECTED RECEPTORS', //
     .      T10,'ANNUAL',3X,2A8//
     .     T10,'MICROGRAMS PER CUBIC METER'//)
C
  991 FORMAT(' ',T10,'AVERAGING TIME ',F4.0,' HOURS'  //
     . T9,18('____'),'__'/
     .T9,'|            |  EXPECTED    |  EXPECTED    |     EXPECTED     |
     .STANDARD    |'  /
     .T9,'| RECEPTOR |  ARITHMETIC  |  GECMETRIC   |     MAXIMUM      |
     .GEOMETRIC   |'        /
     .T9,'| NUMBER   |',T26,'MEAN     |      MEAN     |  CONCENTRATION  |
     .  DEVIATION   |'         )
C
  992 FORMAT(' ',T9,'|',T14,I3,T20,'|',T23,F5.0 ,T35,'|',T38,F5.0 ,T50,
     . '|',T54,F5.0 ,T68,'|',T73,F5.2,T83,'|' )
  993 FORMAT(1H+,T9,18('____'),'__' )
  994 FORMAT(' ',T9,'|',T20,'|',T35,'|',T50,'|',T68,'|',T83,'|'  )
C
      END
```

SUBROUTINE SELECT

Purpose:

1. Computation and output of statistical data for 12 selected receptor points.
2. Computation and output of the source contribution percentage for the five receptors with the largest concentrations or the five selected receptors as input.

Input:

ISEL (2,5) ---------------------- 5 receptors for output with their source contributions.

NSEL5 --------------------------- 0 5 receptors are maximum from SØRT
1 5 receptors were selected as input

SCON (5) ------------------------ source contributions per receptor

NSEL12 -------------------------- 0 12 receptors for output have not been selected
1 12 receptors have been selected

IPOLUT1, LPOLUT2 ---------------- DØ-loop limits for the pollutants

NSØRCE -------------------------- number of sources

CPOLUT (2,237) ------------------ arithmetic mean concentration values at each receptor

Output:

SPER(5) ------------------------- percentage contribution of each source to each of the five receptors

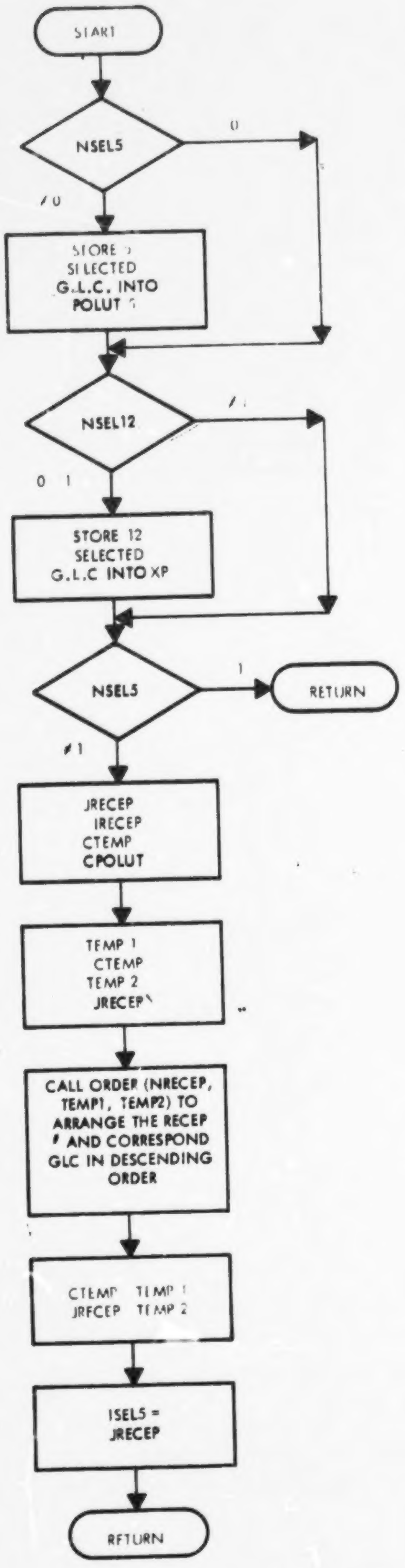
Procedure:

1. Determine if 12 receptors have been selected. If yes, call SEL12.
2. Call POLUT to compute each source contribution and total contribution for each of the five receptors.
3. Compute the percentage contribution of each source to each receptor.
4. Output the percentages.

Subroutine Called:

SEL12, PØLUT2

SUBROUTINE SELECT



```
      SUBROUTINE SELECT
      COMMON /AIRQ/ AVRGTM(2,3),STANDV(2,12)
      COMMON /CONS/ PI4,PI8
      COMMON /CORD/ RBASE(2),DELTA,INCRX,INCRY,GDSCAL,QSCALE
      COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /LITL/ REGION(18)
      COMMON /LOGI/ SGTDMX,IPNCH
      COMMON /RCPT/ RECEPT(2,237),CPOLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IADD,JRECEP(2,237),POLUT5(2,5),
     3              PT5(2,5)
      COMMON /REST/ A(7),B(7),C(7)
      COMMON /RGSN/ AC(2),BC(2),CORREL(100)
      COMMON /SELC/ ISEL12(2,12),NSEL12,ISEL5(2,5),NSEL5,XP(2,12)
      COMMON /SRCE/ SORCE(6,1000),PLUME(3,1000),CS(2,1000),BACKGR(2),
     1              IFLAG,NSORCE,TA,PA
      COMMON /WIND/ WNDFRQ(6,16,5),UU(6),SINWD(16),COSWD(16),DPTHMX
      REAL*8 AI(4)/'SO2     ','        ','PARTICUL','ATES    '/
C
      REAL*8 FNAME(2)/'MAXIMUM ','SELECTED'/
C
      DIMENSION SPER(5),SCON(5),SUMSP(5),SUMSC(5),BGPER(5),POL5(5)
C
C  SUBROUTINE SELECT WILL CALL SEL12 IF 12 RECEPTORS HAVE BEEN SELECTED.
C     IN ADDITION, 5 RECEPTORS ARE OUTPUTTED WITH THE PERCENTAGE  PER
C     SOURCE CONTRIBUTION FOR EACH POLLUTANT.
C     THESE 5 RECEPTORS ARE THE LARGEST CONCENTRATION POINTS.
C
C
C  TEST FOR 12 SELECTED RECEPTORS.
C
      IF (NSEL12 .EQ. 0) GO TO 50
      CALL SEL12
C
C  COMPUTE SOURCE CONTRIBUTION PERCENTAGES.
C
   50 DO 71 IPOLUT= IPOLU1,IPOLU2
      ACPRME = AC(IPOLUT) + (BC(IPOLUT) - 1.) * BACKGR(IPOLUT)
      DO 10 I=1,5
      SPER(I) = 0.0
      SUMSP(I) = 0.0
      SUMSC(I) = 0.0
      BGPER(I) = 0.0
      POL5(I) = 0.
   10 SCON(I)=0.
C          ICNT IS THE LINE COUNT.
      ICNT  =  0
      KK = 0
      KK= INC(IPOLUT)
      IF (NSEL5 .EQ. 0) GO TO 52
      DO 51 K = 1,5
      IF (ISEL5(IPOLUT,K) .LE. 0) GO TO 51
      KK = K
   51 CONTINUE
   52 CONTINUE
      IF (KK .LE. 0) GO TO 71
C
C  SKIP PAGE AND WRITE HEADER LINE.
C            IN SELECT
      IA = NSEL5 + 1
      J1 = IPOLUT*2 - 1
      J2 = J1 + 1
      WRITE(6,990) REGION,FNAME(IA),(AI(M),M=J1,J2)
      WRITE (6,991)
      WRITE (6,992) (ISEL5(IPOLUT,I),I=1, 5)
C
C     USE UNCALIBRATED FORM OF CPOLUT
      DO 55 I=1,KK
      IF (NSEL5.EQ.0) POLUT5(IPOLUT,I)=CPCLUT(IPOLUT,I)
      POL5(I)    =       (POLUT5(IPOLUT,I)-AC(IPOLUT))/BC(IPOLUT)
     1                    -BACKGR(IPOLUT)
   55 CONTINUE
   56 CONTINUE
      DO 70 ISORCE= 1,NSORCE
      DO 60  I=1,KK
C                              ISEL5 = 5 RECEPTORS I/P OR MAXIMUM
      IRECEP=ISEL5(IPOLUT,I)
      CS(IPOLUT,ISORCE)=0.
C
      CALL POLUT2 (IPOLUT,ISORCE)
C                   SPER = SOURCE CONT. % ; SCONT = SOURCE CONTRIBUTION.
      SCON(I)=CS(IPOLUT,ISORCE)*BC(IPOLUT)
     .          + ACPRME * (CS(IPOLUT,ISORCE) / POL5(I))
      SPER(I) = (SCON(I) / POLUT5(IPOLUT,I)) * 100.
      SUMSP(I) = SUMSP(I) + SPER(I)
 60   SUMSC(I) = SUMSC(I) + SCON(I)
C  OUTPUT THE 5 RECEPTOR DATA
C
C  WRITE A DATA LINE
C
      WRITE (6,999) ISORCE, (SPER(I),I=1,KK),(SCON(I),I=1,KK)
C                     ICNT = NUMBER OF LINES WRITTEN PER PAGE.
      WRITE(6,993)
      ICNT = ICNT + 2
C
      IF (ICNT .LE. 40) GO TO 70
C
C   A PAGE IS FULL INITIALIZE FOR NEXT PAGE
C
      ICNT = 0
```

```
C
C
      IA = NSEL5 + 1
      J1 = IPOLUT*2 - 1
      J2 = J1 + 1
      WRITE(6,990) REGION,FNAME(IA),(AI(I),I=J1,J2)
      WRITE (6,991)
       WRITE (6,992) (ISEL5(IPOLUT,I),I=1,5)
C
   70 CONTINUE
      DO 69 I=1,KK
      BGPER(I) = BACKGR(IPOLUT) / POLUT5(IPOLUT,I) * 100.
      SUMSP(I) = SUMSP(I) + BGPER(I)
      SUMSC(I) = SUMSC(I) + BACKGR(IPCLUT)
   69 CONTINUE
  324 FORMAT(T10,'|',T14,'BACK-',T21,5('| ',F7.2,' %  '),'|'/
     .        T10,'|',T13,'GROUND',T21,5('| ',F5.0,6X),'|')
      WRITE (6,993)
      WRITE(6,325)(SUMSP(I),I=1,KK),(SUMSC(I),I=1,KK)
  325 FORMAT (T10,'|',T14,'TOTAL',T21,5('| ',F7.2,' %  '),'|'/
     1        T10,'|',T21,5('| ',F9.4,2X),'|')
      WRITE(6,993)
   71 CONTINUE
C
      RETURN
  990 FORMAT('1',T10,18A4,   //
     .             T10,'SOURCE CONTRIBUTIONS TO FIVE ', A8,' RECEPTORS',//
     .      T10,'ANNUAL',3X,2A8//
     .       T10,'MICROGRAMS PER CUBIC METER'///)
  991 FORMAT(T10,19('____'),'_')
  992 FORMAT(T10,'| SOURCE',T21,5('|  RECEPTOR  '),'|'/T10,'|',T21,5('|'
     1,3X,I3,6X),'|' ,/'+',T10,19('____'),'_')
  993 FORMAT('+',T10,19('____'),'_')
  999 FORMAT(' ',T10,'|',T14,I3,T21,5('| '  ,F7.1,' %  '),'|'/T10,'|',T2
     .1,
     1 5('| ',F9.4,2X),'|')
C
      END
```

SUBROUTINE SØRT

Purpose:

This routine is another subdriver to arrange the computed concentration values in descending order by calling ØRDER. It also tests the values in NSEL5 and NSEL12 to decide whether the five receptors for source contribution output will be the five maximum receptors or five selected (input) receptors. It also decides whether to have twelve-receptor statistical output or not.

Input:

NSEL5	flag to determine the mode to the 5 receptors for source contribution output.
NSEL12	flag to determine whether or not to have the 12-receptor statistical output
CPØLUT (2, 237)	computed concentration values
ISEL5 (2, 5)	5 selected receptor numbers for each pollutant
ISEL12 (2, 12)	12 selected receptor numbers for each pollutant

Output: (Intermediate)

PØLUT5	concentration values for 5 selected receptors.
CPØLUT (2, 237)	ordered array of concentration values
JRECEP (2, 5)	receptor numbers for maximum-concentration points

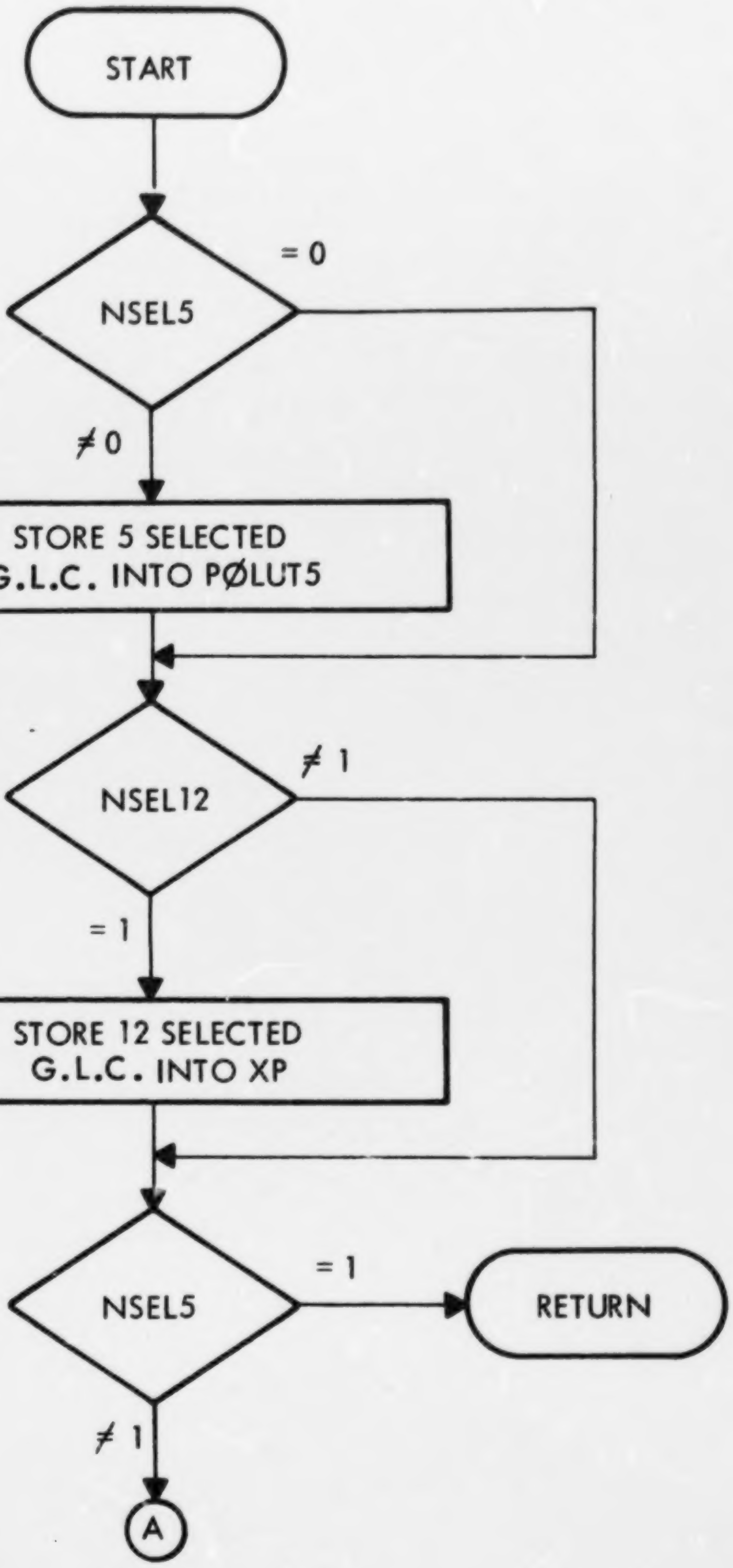
Procedure:

1. Test NSEL5. Store 5 selected concentration values into PØLUT5 if NSEL5 equals 1.
2. Test NSEL12. Store 12 selected concentration values into XP if NSEL12 equals 1.
3. Test NSEL5. If it equals zero, call ØRDER to arrange the concentration values into descending order.

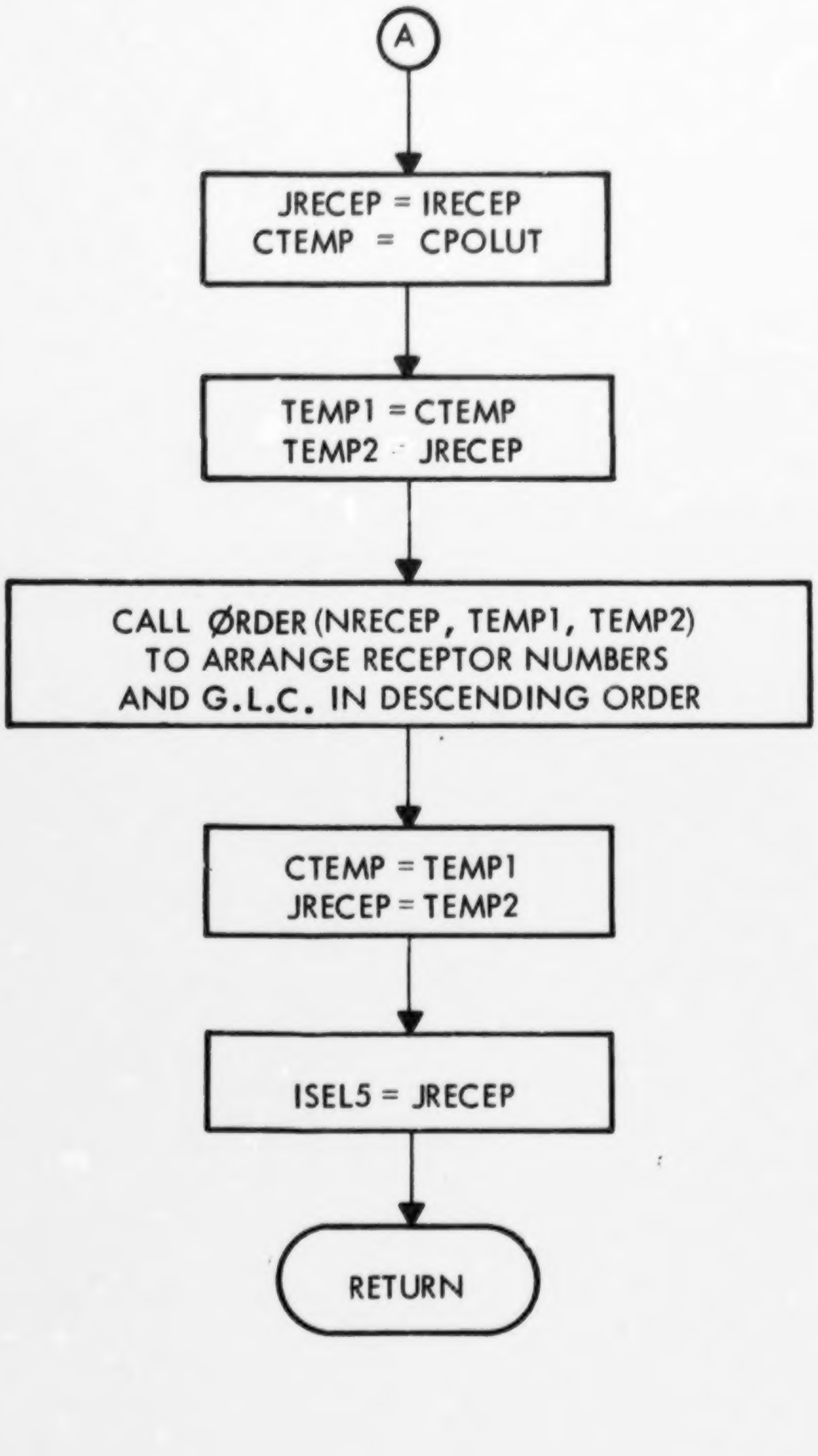
Subroutine Called:

ØRDER

SUBROUTINE SORT


START
NSEL5
= 0
≠ 0
STORE 5 SELECTED G.L.C. INTO PØLUT5
NSEL12
≠ 1
= 1
STORE 12 SELECTED G.L.C. INTO XP
NSEL5
= 1
RETURN
≠ 1
A

SUBROUTINE SORT (Continued)



```
      SUBROUTINE SORT
C
C     SORT DETERMINES THE 5 RECEPTOR VALUES(WHETHER SELECTED OF MAX.)
C     FOR SOURCE CONTRIBUTION OUTPUT, DETERMINES WHETHER 12  RECEPTOR
C     STATISTICAL OUTPUT IS DESIRED, AND CALLS ORDER TO ARRANGE THE
C     COMPUTED G.L.C. IN DESCENDING ORDER.
C
       COMMON /DOLP/ IPOLU1,IPOLU2,INC(2)
      COMMON /RCPT/ RECEPT(2,237),CPOLUT(2,237),SO2LOC(2,100),
     1              PARLOC(2,100),SO2OBS(100),PAROBS(100),NSO2,NPART,
     2              IRECEP,XRECEP(2,12),IACD,JRECEP(2,237),POLUT5(2,5),
     3              PT5(2,5),NRECEP
      COMMON /SELC/ ISEL12(2,12),NSEL12,ISEL5(2,5),NSEL5,XP(2,12)
      EQUIVALENCE (CPOLUT(1,1), CTEMP(1,1))
      DIMENSION CTEMP(2,237)
      DIMENSION TEMP1(200),TEMP2(200)
      IRECEP=0
      DO  9 IPOLUT=IPOLU1,IPOLU2
C
C     STORE CONCENTRATION VALUES IF 5 RECEPTORS ARE SELECTED
      IF (NSEL5.EQ.0) GO TO 86
      DO 85 I=1,5
      IREC5=ISEL5(IPOLUT,I)
      POLUT5(IPOLUT,I)=CPOLUT(IPOLUT,IREC5)
   85 CONTINUE
   86 CONTINUE
C
C
C     STORE 12 CPOLUT VALUES IF NSEL12=1
C
      IF (NSEL12.NE.1) GO TO 500
      DO 400 I=1,12
      IRECEP=ISEL12(IPOLUT,I)
      IF (IRECEP .EQ. 0) GO TO 500
  400 XP(IPOLUT,I) = CPOLUT(IPOLUT,IRECEP)
C     TEST NSEL5, IF NOT 1, STORE RECEPTOR NUMBERS OF 5 MAX CPOLUT
C     IN ISEL5(2,5)
C
  500 IF (NSEL5 .EQ. 1) GO TO 9
      DO  8 IRECEP=1,NRECEP
C
C
      JRECEP(IPOLUT,IRECEP)= IRECEP
      CTEMP(IPOLUT,IRECEP)=CPOLUT(IPOLUT,IRECEP)
C
    8 CONTINUE
C
      DO 1501 I=1,NRECEP
      TEMP1(I)=CTEMP(IPOLUT,I)
 1501 TEMP2(I)=JRECEP(IPOLUT,I)
      CALL ORDER (NRECEP,TEMP1,TEMP2)
      DO 502 I=1,NRECEP
      CTEMP(IPOLUT,I)=TEMP1(I)
  502 JRECEP(IPOLUT,I)=TEMP2(I)
C
      INC(IPOLUT)=5
      KKK=INC(IPOLUT)
      DO 499 K=1,KKK
  499 ISEL5(IPOLUT,K)=JRECEP(IPOLUT,K)
C
    9 CONTINUE
C
   10 CONTINUE
      RETURN
      END
```

SUBROUTINE ZVALU2

Purpose:

1. To compute Z, reduced normal variate

Input:

P ---------------------------- percent value expressed in decimal

Output:

Z ---------------------------- reduced normal variate

Procedure:

1. Compute U:

$$U = (\ln [1/P^2])^{1/2}$$

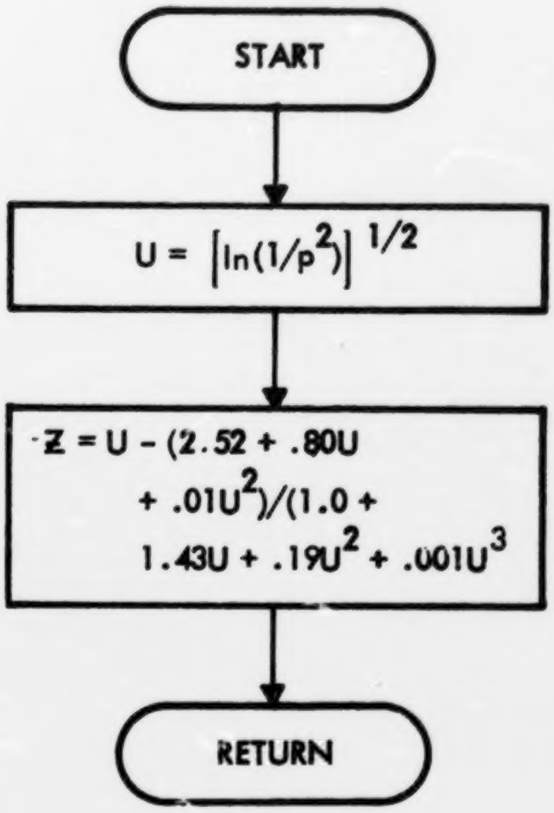
2. Compute Z:

$$Z = U - (2.52 + .80U + .01U^2)/(1.0 + 1.43U + .19U^2 + .001U^3)$$

Subroutine Called:

None

SUBROUTINE ZVALU2


START
$U = \left[\ln(1/p^2)\right]^{1/2}$
$Z = U - (2.52 + .80U + .01U^2)/(1.0 + 1.43U + .19U^2 + .001U^3$
RETURN

```
      SUBROUTINE ZVALU2(P,Z)                                            ZVAL   0
C                                                                       ZVAL  10
C     P=PERCENT VALUE EXPRESSED IN DECIMAL                              ZVAL  20
C                                                                       ZVAL  30
C     Z=REDUCED NORMAL VARIATE                                          ZVAL  40
C                                                                       ZVAL  50
      A0=2.515517                                                       ZVAL  60
      A1=0.802853                                                       ZVAL  70
      A2=0.010328                                                       ZVAL  80
      B1=1.432788                                                       ZVAL  90
      B2=0.189269                                                       ZVAL 100
      B3=0.001308                                                       ZVAL 110
      U=SQRT(ALOG(1./(P*P)))                                            ZVAL 120
      Z=U-(A0+A1*U+A2*U*U)/(1.+B1*U+B2*U*U+B3*U*U*U)                    ZVAL 130
      RETURN                                                            ZVAL 140
      END                                                               ZVAL 150
```

AQDM MACHINE CONFIGURATION

Computer:	IBM 360/40
System:	OS MFT-II release 17
Program Language:	FORTRAN IV G
Core Needed:	100K bytes with overlay 120K bytes without overlay
I/O Needed:	1-IBM 2540 Card read/punch 1-IBM 1403 Printer

JOB CONTROL LANGUAGE SET-UPS[1,2] FOR AQDM

I. Compile, load, and execute with overlay.[3]

```
 //       JOB
//CLGD   EXEC  PROC=FORTGCLG,PARM.FORT='MAP',PARM.LKED=(MAP,OVLY,XREF)
//FORT.SYSIN  DD *
              SOURCE DECKS GO HERE

/*
//LKED.SYSIN DD *
 OVERLAY A
 INSERT  CONVRT,IHCNAMEL
 OVERLAY A
 INSERT DIFMOD
 OVERLAY B
 INSERT CAMP,REG,POLUT1
 OVERLAY B
 INSERT POLUT
 OVERLAY B
 INSERT SORT,ORDER,PLOT
 OVERLAY A
 INSERT SELECT,SEL12,POLUT2,ZVALU2
//GO.SYSIN   DD  *
            INPUT DATA GOES HERE
 /*
```

---

[1] IBM System/360, Job Control Language, Form C28-6539-8

[2] IBM System/360, FØRTRAN IV (G and H) Programmer's Guide, Form C28-6817-0

[3] IBM System/360, Linkage Editor, Form C28-6538-6

To run AQDM without overlay, remove the OVLY from the EXEC card and remove Section I.a.

II. Load and execute with overlay

```
//         JOB
//LG      EXEC  PROC=FORTGLG,PARM.LKED=(MAP,OVLY,XREF)
//LKED.SYSIN DD *
                    OBJECT DECKS GO HERE

 OVERLAY A
 INSERT  CONVRT,IHCNAMEL
 OVERLAY A
 INSERT DIFMOD
 OVERLAY B
 INSERT CAMP,REG,POLUT1
 OVERLAY B
 INSERT POLUT
 OVERLAY B
 INSERT SORT,ORDER,PLOT
 OVERLAY A
 INSERT SELECT,SEL12,POLUT2,ZVALU2
/*
//GO.SYSIN   DD  *
              INPUT DATA GOES HERE
/*
```

To run AQDM without overlay, remove the OVLY from the EXEC card and remove the overlay cards.

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